ENGINEERING AND

BOILER HOUSE REVIEW

ESTABLISHED 1899

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VOL. 74 NO. 5 • THE PIONEER STEAM JOURNAL • MAY, 1959

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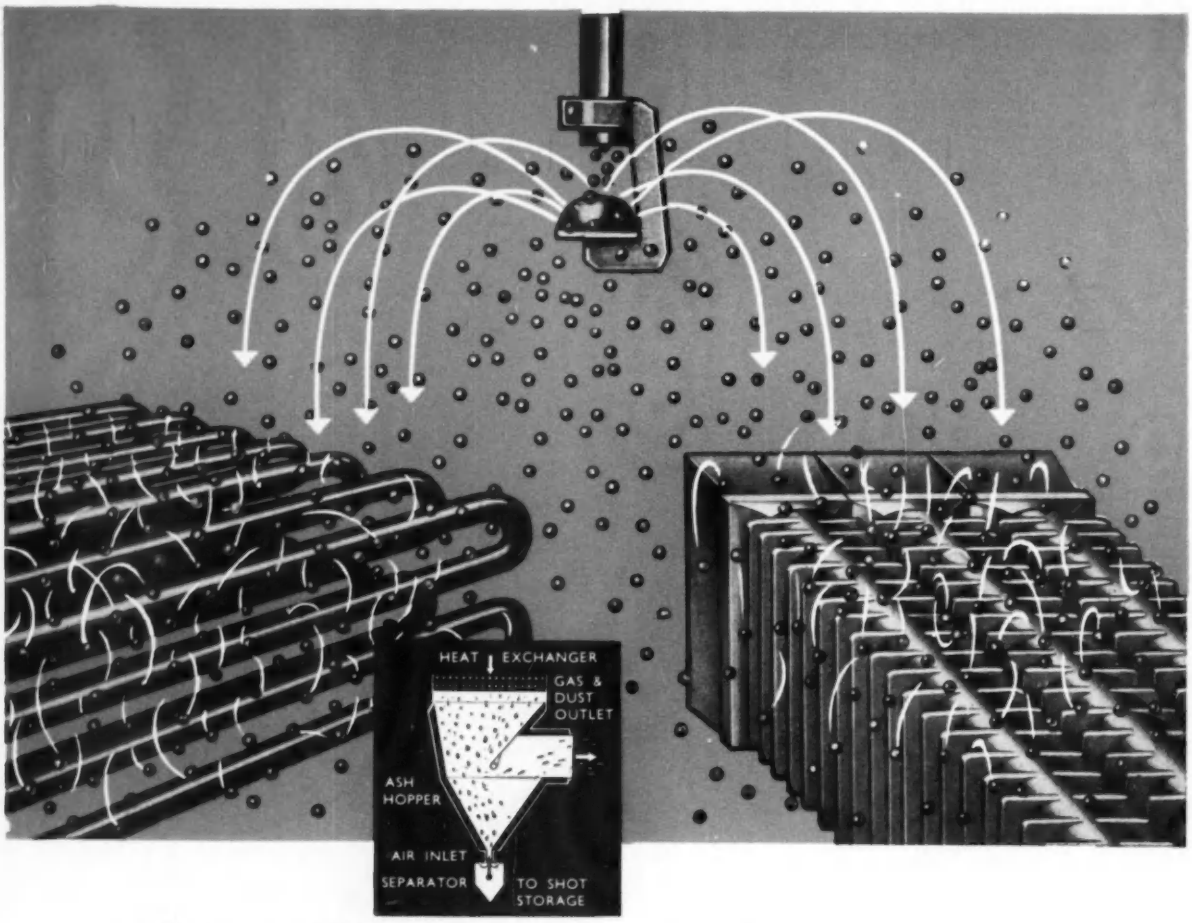

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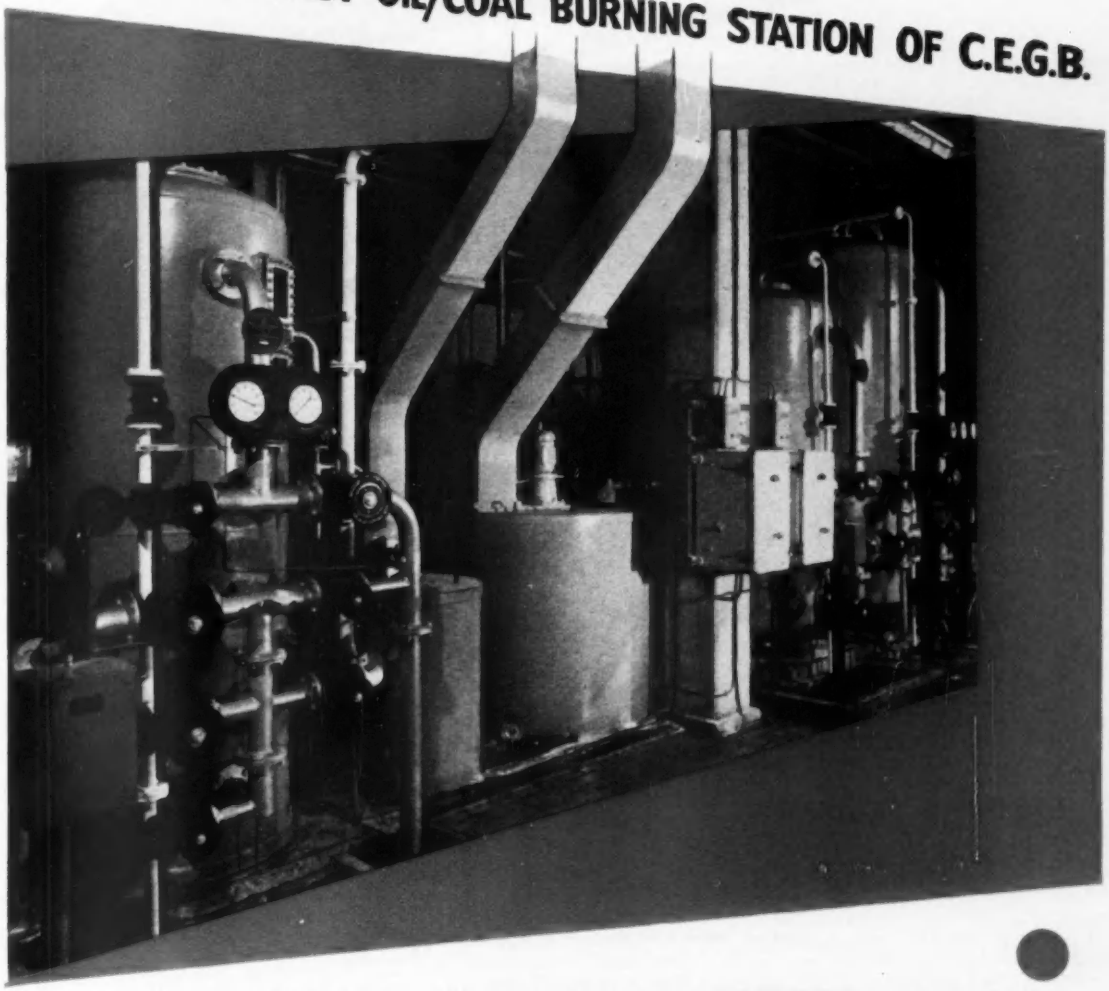

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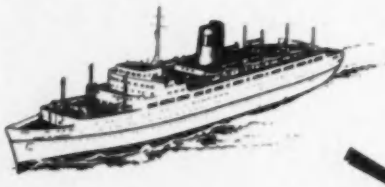

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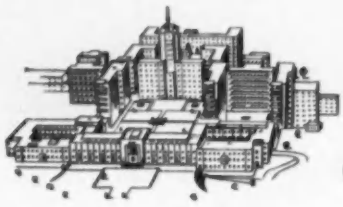

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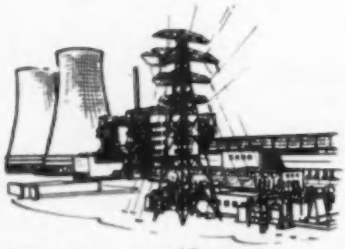

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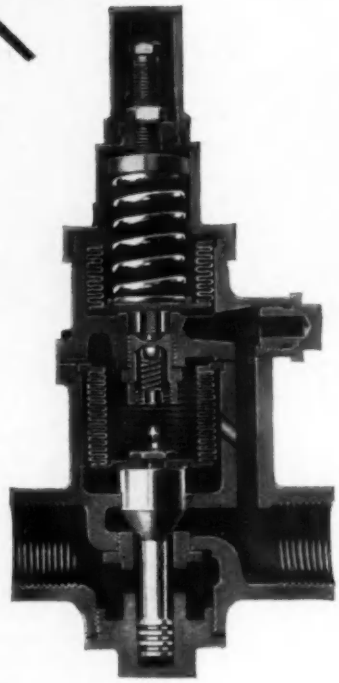

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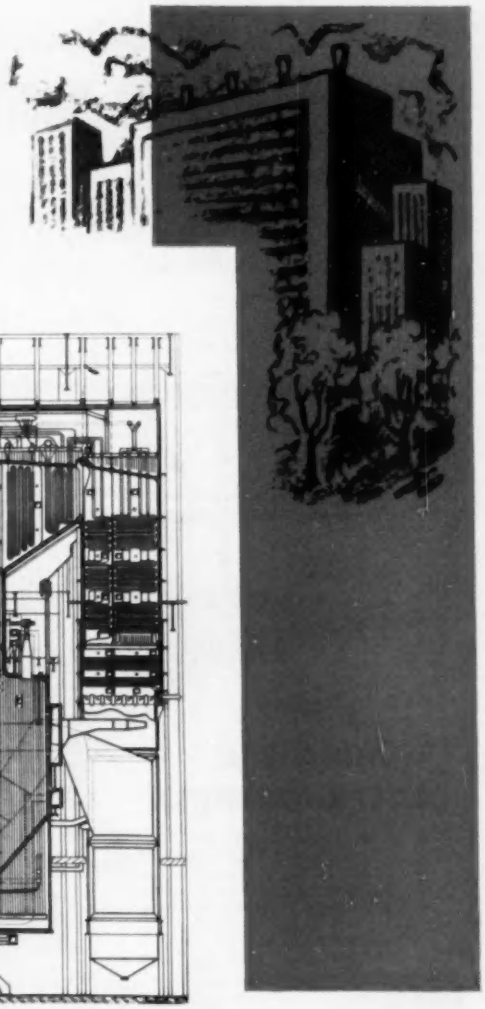

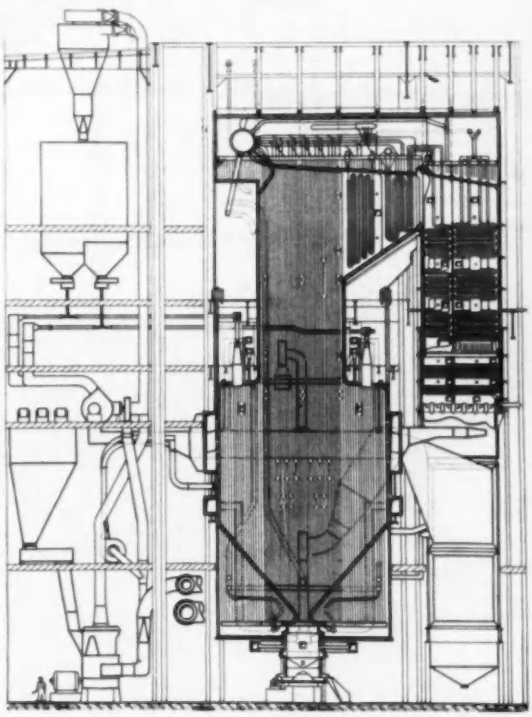

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For capacities above 10 gallons per hour using 220 secs and 950 secs oil. Gives clean combustion and 13% CO_2 at variable firing loads. Incorporates one small and one large air register, each with its own atomiser. On low load only the small burner is alight, at high load both are working at optimum efficiency. Large burner has tip shut off, arranged for hot oil circulation to start and self cooling on shut down.

Type F Burner
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Available in capacities from 20 lbs. to 90 lbs. per hour, using 220 secs oil. Air/Oil ratios and pressures are factory set to give suspended intense flame with 13% CO_2, and do not require further adjustment on site.

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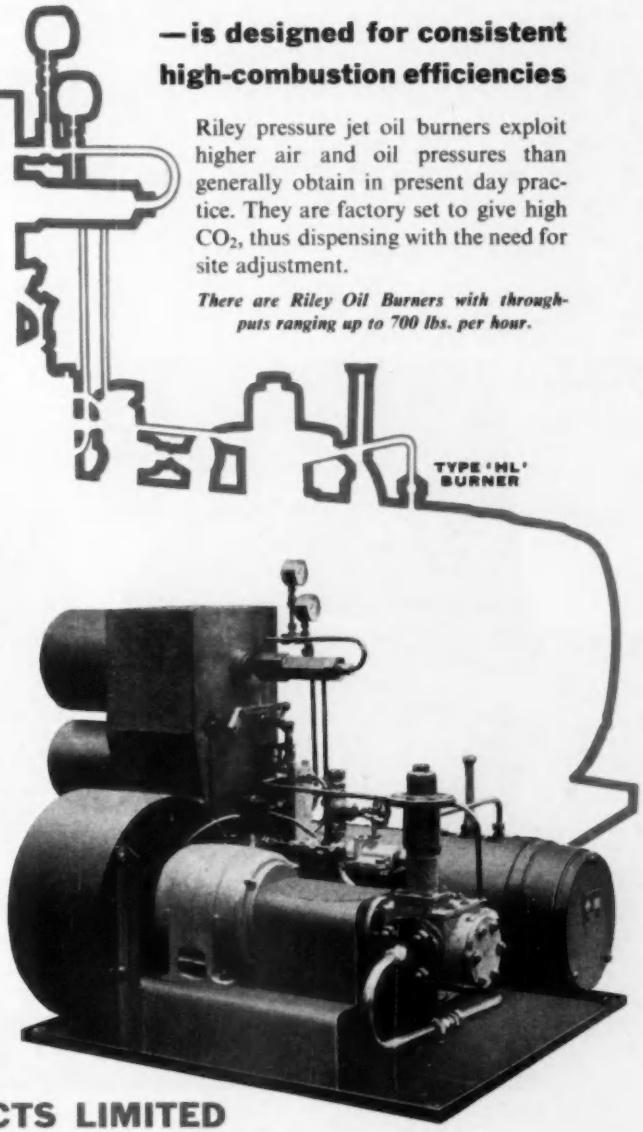

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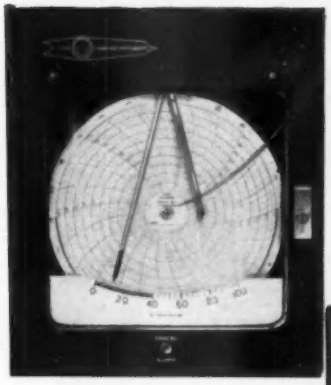
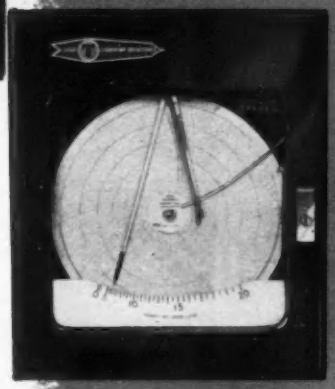




John Thompson 'Sentinel' Series

The illustrations show two of the comprehensive series of "Sentinel" Instruments. Left above is the Smoke Density Recorder and Indicator which provides a reliable and inexpensive means of meeting the requirements of the Clean Air Act 1956, and at the same time serves as a guide to efficient combustion.

Left below is the "Sentinel" Flow Meter, available in a variety of forms for measurement and recording of flow of steam, air, gases and liquids. If required, pressure and temperature measurement can be incorporated in the same instrument.

Above: Smoke Density Recorder and Indicator with warning lamps; a warning klaxon or other remote alarm system can be incorporated.

Right: Recording, Indicating and Counting Flow Meter: pointer visually indicates flow, whilst recording pen makes a permanent chart record and integrator mechanism gives a numerical count of flow.

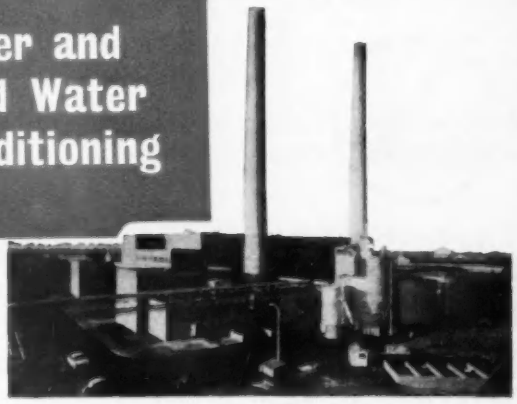
JOHN THOMPSON GROUP

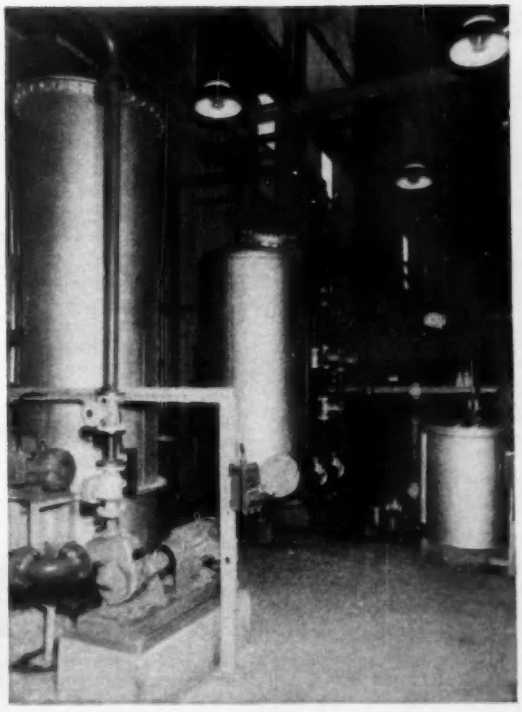
JOHN THOMPSON INSTRUMENT CO LTD. WOLVERHAMPTON

MF.10

The illustrations show (below) a typical John Thompson-Kennicott Lime Soda water treatment plant at a works of Lever Brothers Ltd., and (right) a plant with cation exchanger employing a selective resin followed by a scrubber for CO_2 removal and a base-exchange softener, producing a water of zero hardness and low alkalinity at Charles Lennig and Co. (Great Britain) Ltd. Complete plants for treatment of water and industrial effluents, etc.

Boiler and Feed Water Conditioning





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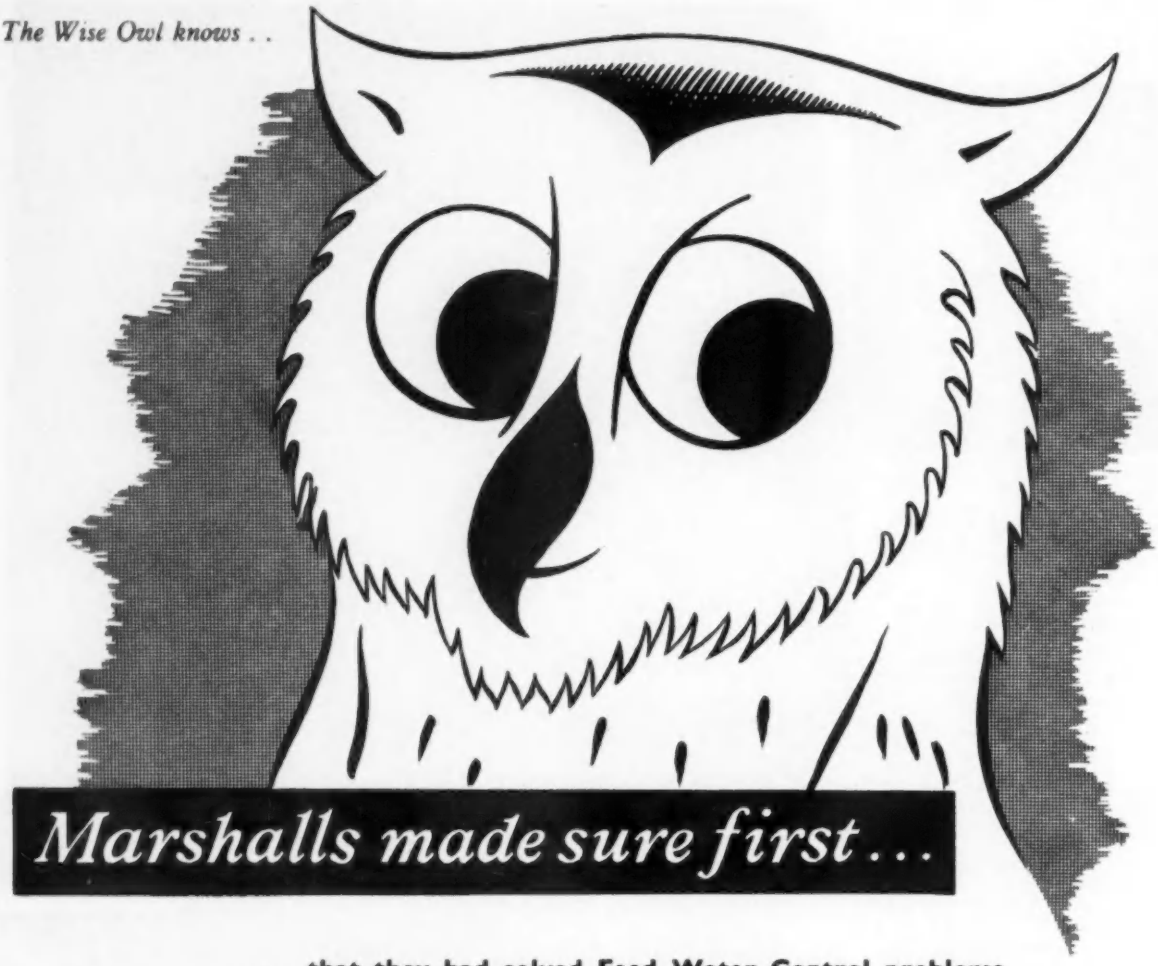

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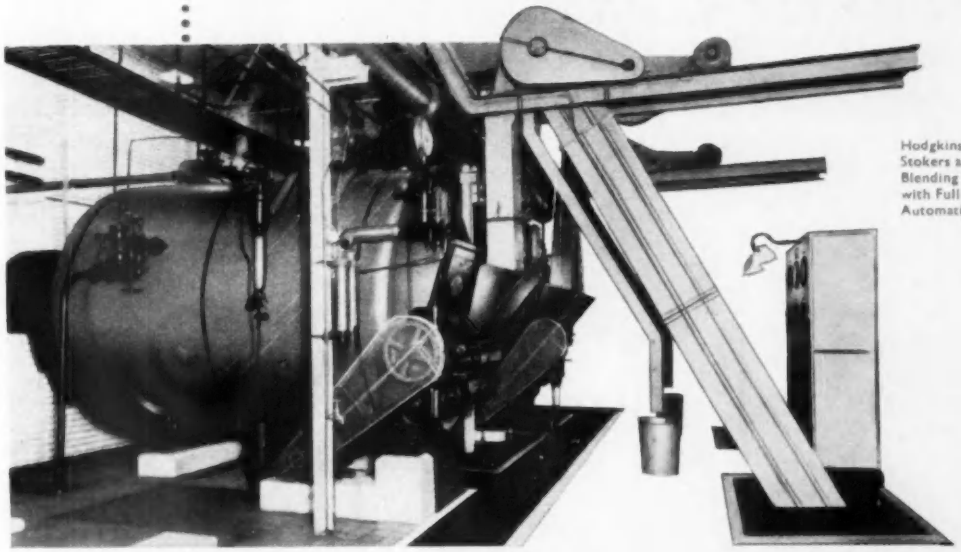

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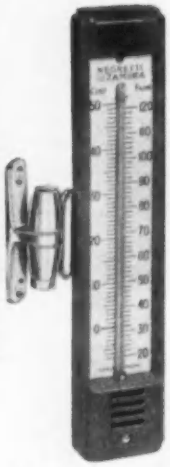

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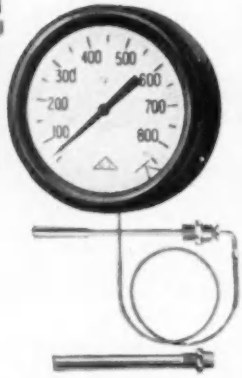
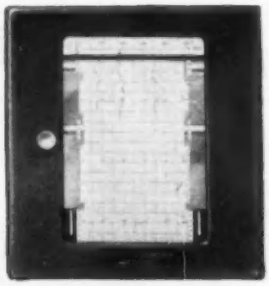
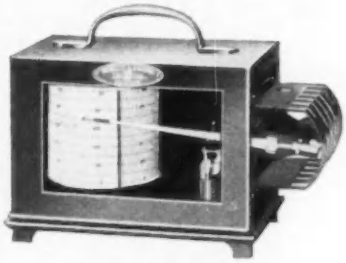


Distance-type Mercury-in-
steel Dial Thermometer



Resistance Thermometer
Recorder



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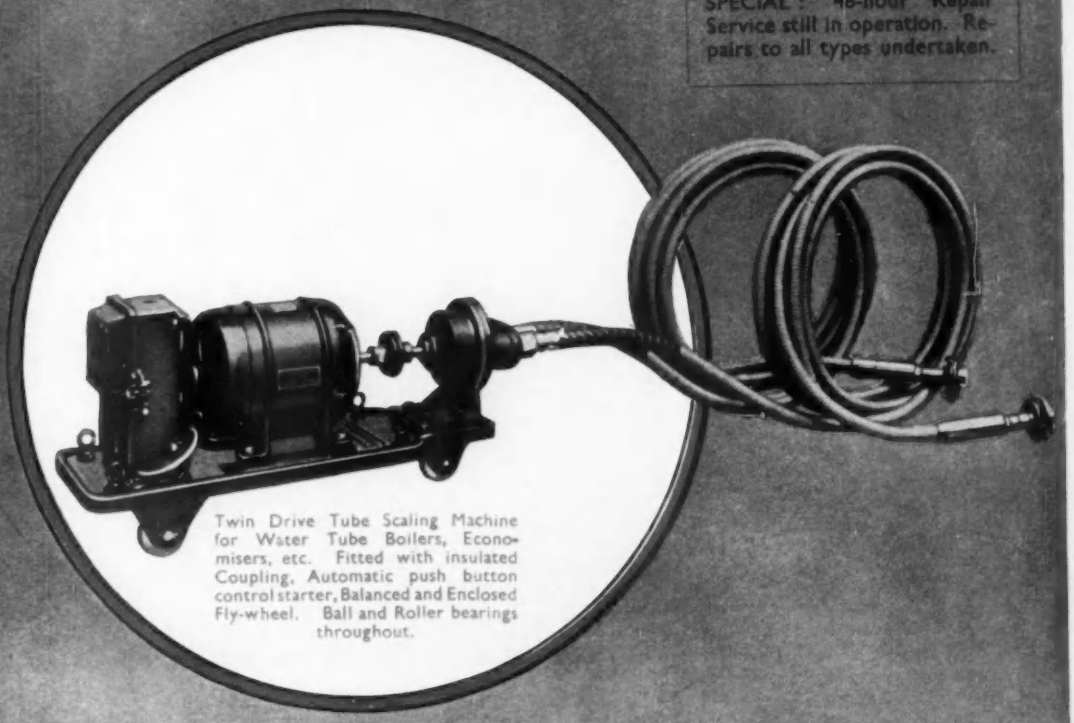

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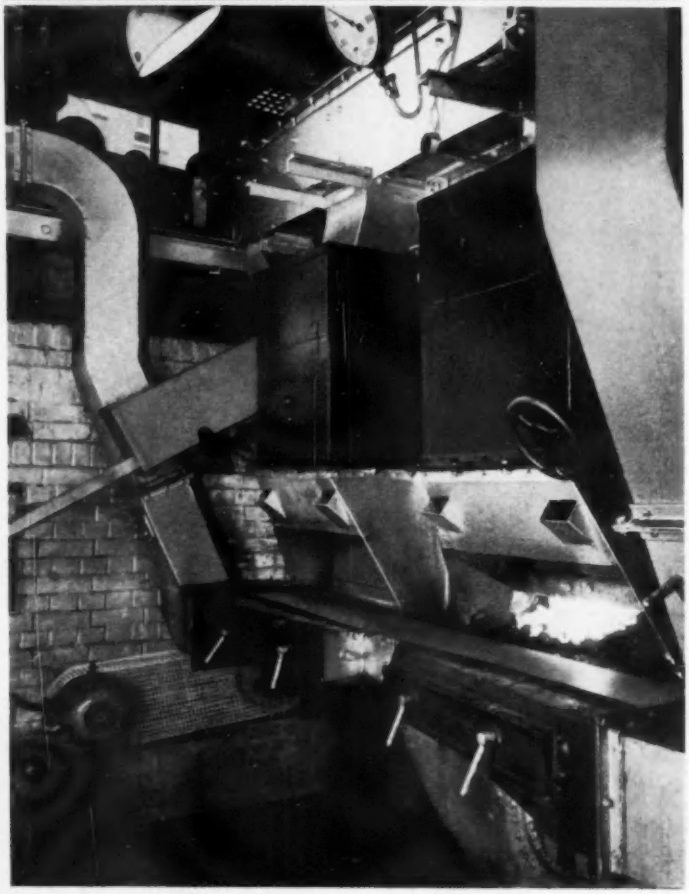

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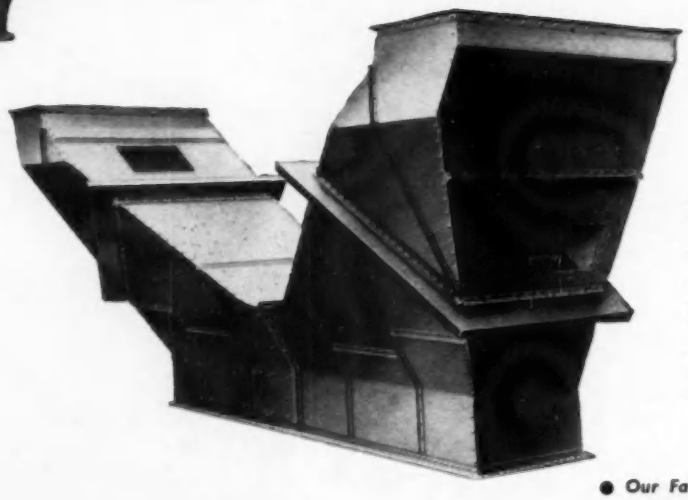

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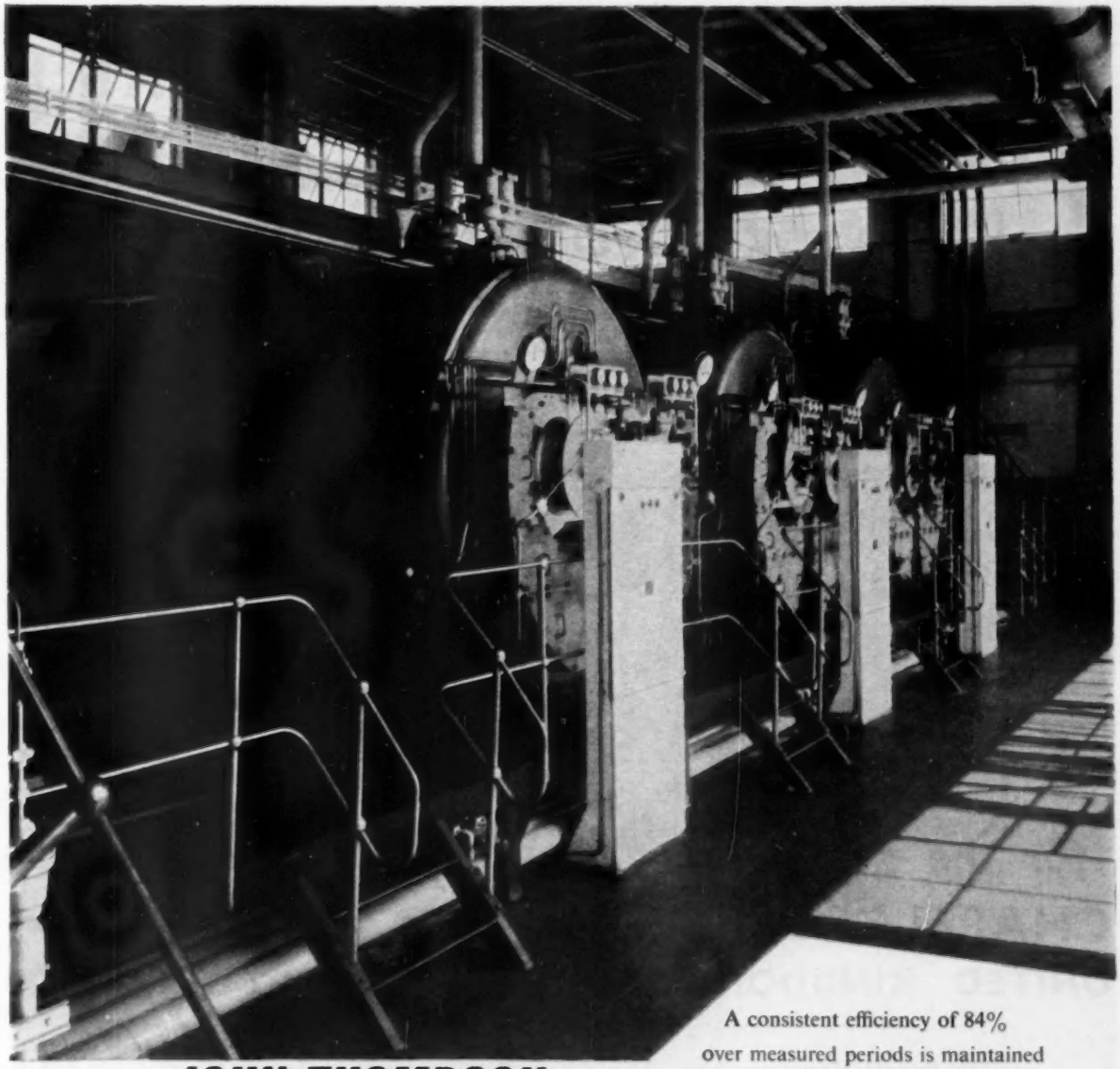

JOHN THOMPSON SUPER ECONOMIC BOILERS at MULLARD Simonstone Works

A consistent efficiency of 84% over measured periods is maintained by these three Super Economic Boilers which provide high pressure hot water at 250°F and 120 p.s.i. at Mullard Simonstone Works. All are oil fired, with a rating of 9250 lb/hr, the third boiler being a standby. Steel chimneys for the installation were made and erected by John Thompson (Dudley) Ltd.

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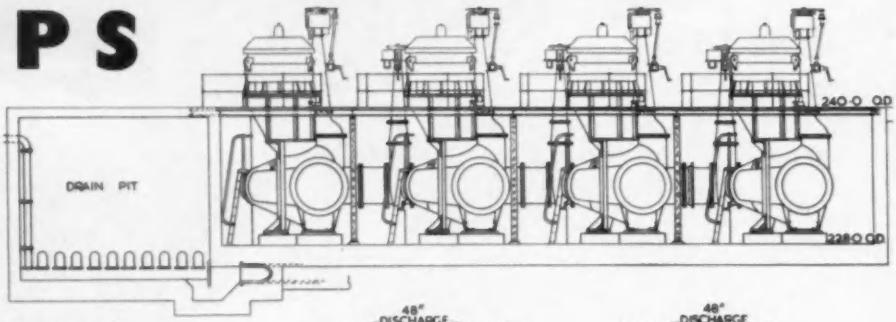
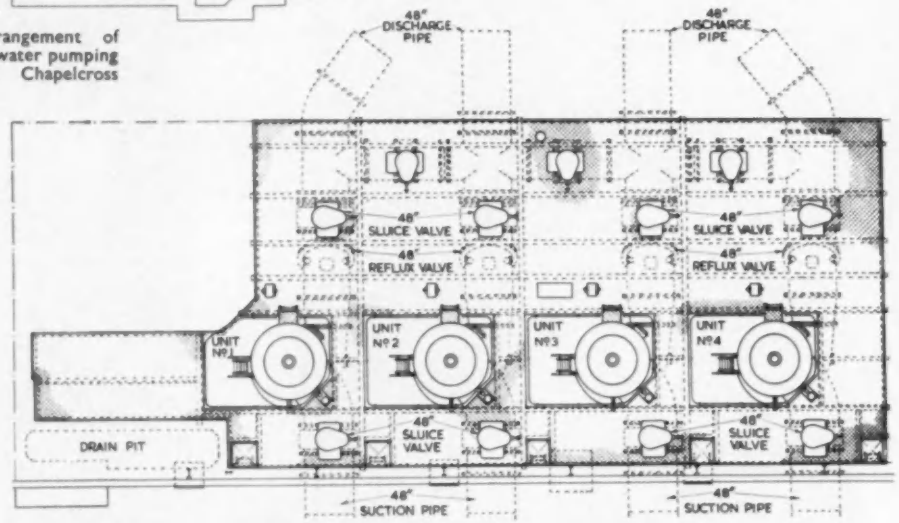
WBI/5

B

ALLEN CIRCULATING-WATER PUMPS





Installation arrangement of the circulating-water pumping units at the Chapelcross Power Station.

for the

CHAPELCROSS POWER STATION of the UNITED KINGDOM ATOMIC ENERGY AUTHORITY

Consulting Engineers: MERZ and McLELLAN

The installation comprises four Allen 48/48-in. vertical double-suction centrifugal pumps, each designed to deliver 50,000 gallons of water per minute against a total head of 67 feet, running at a speed of 490 r.p.m., and driven by a 1,225-h.p. L.S.E. motor.

Allen centrifugal and mixed-flow pumps, horizontal or vertical, are designed to meet all requirements up to the largest capacity units needed in modern power station service.

Also for power station pumping applications, Allen-Stoeckicht patented double-helical epicyclic gearing offers a very compact and low-weight speed-reduction or speed-increasing arrangement to suit all powers and speed ratios.

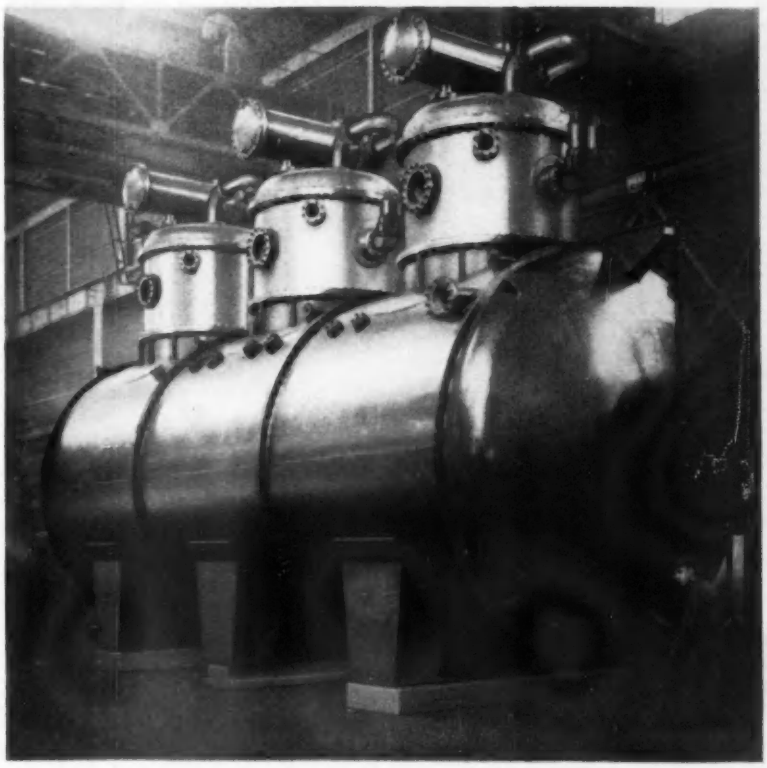
Specialists in complete Pumping Plant installations

W. H. ALLEN SONS & Co LTD

BEDFORD ■ ENGLAND

Weir DE-AERATORS

eliminate oxygen corrosion in the power plant



Prolong life of boiler tubes, economisers, valves and other surfaces.

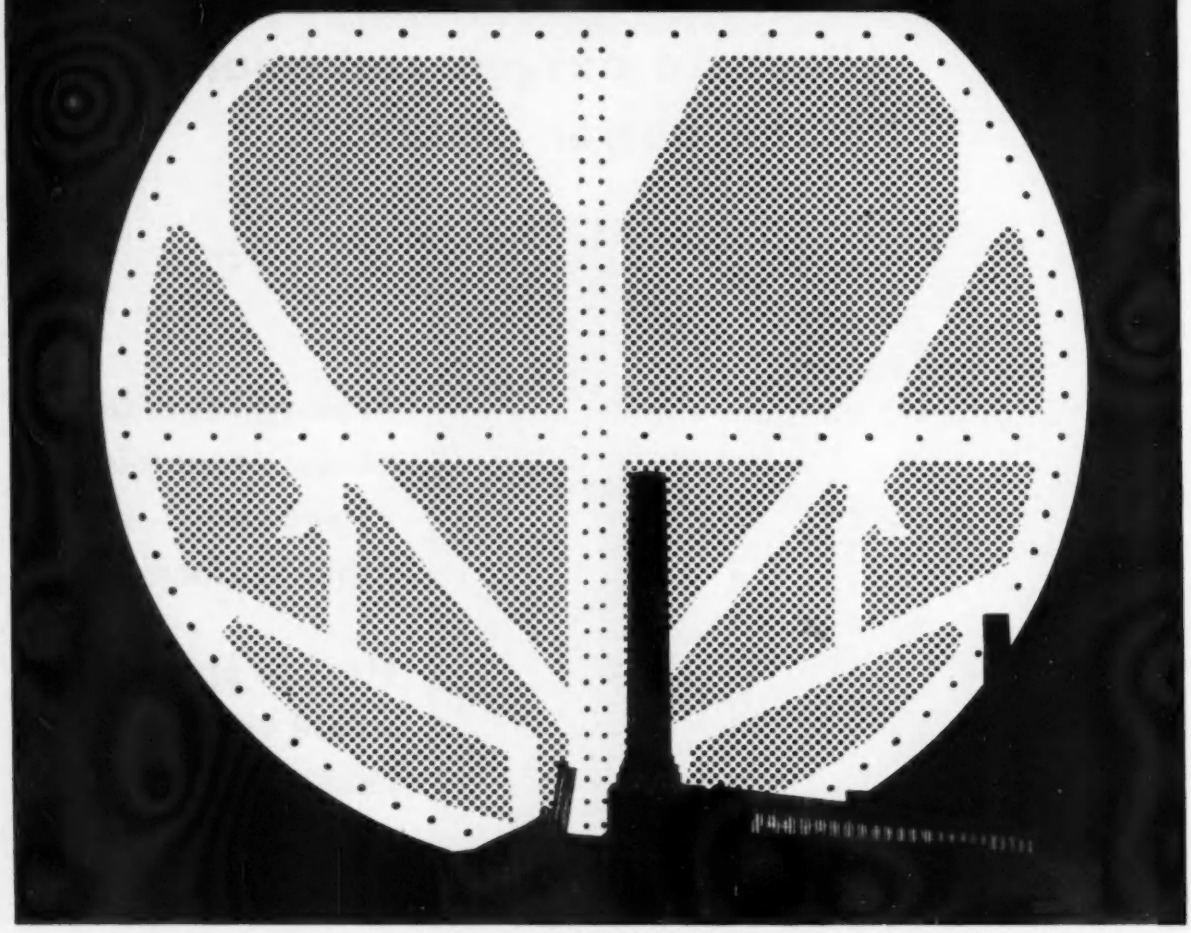
Heat in operating steam retained in feed-water.

The Weir triple De-aerators illustrated are mounted on a feed tank 35 ft. long, 12 ft. 6 in. diameter, and have a normal output of 1,300,000 lb./hr. at 280° F.

We invite enquiries for the most suitable equipment to meet specified requirements.

Weir G. & J. WEIR LTD · CATHCART · GLASGOW S.4

Condensers and Feed Heaters



Our fabricating shops at Hartlepool are equipped to build the largest power station condensers, and in the same works we build feed heaters, air ejectors, de-aerators and cooling water strainers.

Also at Hartlepool in the recently completed extension to our Turbine Shop we can build the largest steam turbines and alternators yet envisaged for public electricity supply. Add to this gas turbines, centrifugal and axial flow blowers, all of Brown Boveri design and also water-tube boilers to Foster Wheeler design, and it will be seen that we can supply all the main items for power production; from an industrial unit, designed to run on by-product fuels or waste heat, to the largest public supply station.

Richardsons Westgarth (HARTLEPOOL) Ltd.

R W G

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And at: 58 Victoria Street, London, S.W.1. 59 Mosley Street, Manchester, 2. 75 Buchanan Street, Glasgow, C.1.

Some of the Creep Testing Machines used in our Research Department.

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SPECIAL STEELS FOR SPECIAL JOBS!

The making of high-grade steel for a diversity of uses—mechanical, structural and scientific—has placed Consett Iron Company Limited in the front rank of the country's steel producers.

The new demands of Industry have brought about the birth of special steels—such as "CONLO 1" giving the highest degree of resistance to brittle fracture of any easily weldable non-alloy steel at present available. This was the steel chosen for the construction of the reactor vessels at Chapelcross and Calder Hall.

After Chapelcross and Calder Hall—Bradwell and Latina. We developed the special steel "BEARCOMO"—in which the widely incompatible requirements of resistance to creep and notch toughness were met and reconciled—specifically for use in the reactor shells in these new and larger power stations.

"BEARCOMO" is one of our patented steels—but, like "CONLO 1," it is only one of our wide range of special steels for special jobs. Our booklet "Steels for the Job" just published at Consett, describes them in some detail. Perhaps you would like to write for a copy.

Our technical and research departments will also welcome enquiries from anyone whose problem is . . . **STEEL.**

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CONSETT, COUNTY DURHAM. Telephone: Consett 341 (12 lines). Telegrams: Steel, Phone, Consett.

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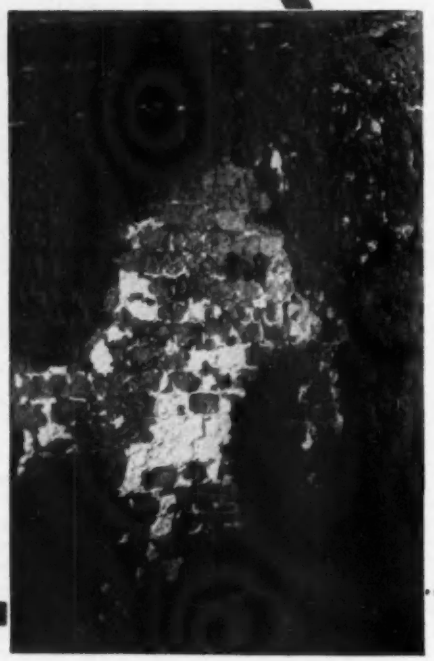
Damaging Slag and Carbon build-up is no longer a problem



DOHMseal, applied to existing refractory linings by brush or to new linings by the " Dipped Brick " technique, forms a tough resistant glaze that retards the build-up of Carbon and Slag and extends the " maintenance free " life of the lining.

These undesirable deposits will eventually form, but DOHMseal ensures their easy removal without damage to the refractory lining.

Fuel saving and reduced maintenance costs result from the use of DOHMseal, which more than pays for the small expenditure incurred.

Repair refractory linings and fabricate monolithic refractory shapes with DOHMpatch—finish with DOHMseal.

CENTRAL ELECTRICITY AUTHORITY, STOKE GENERATING STATION.

Close-up of slag adherence chipped away, showing DOHMseal treated bricks beneath. Without the application of DOHMseal the boilers need to be rebricked every six months.

By treating bricks with DOHMseal, which allows easy removal of slag, there is no necessity to rebrick for a year or more.

Write or telephone for full details:

MELLOR MINERAL MILLS LTD

ONE OF THE DOHM GROUP OF COMPANIES

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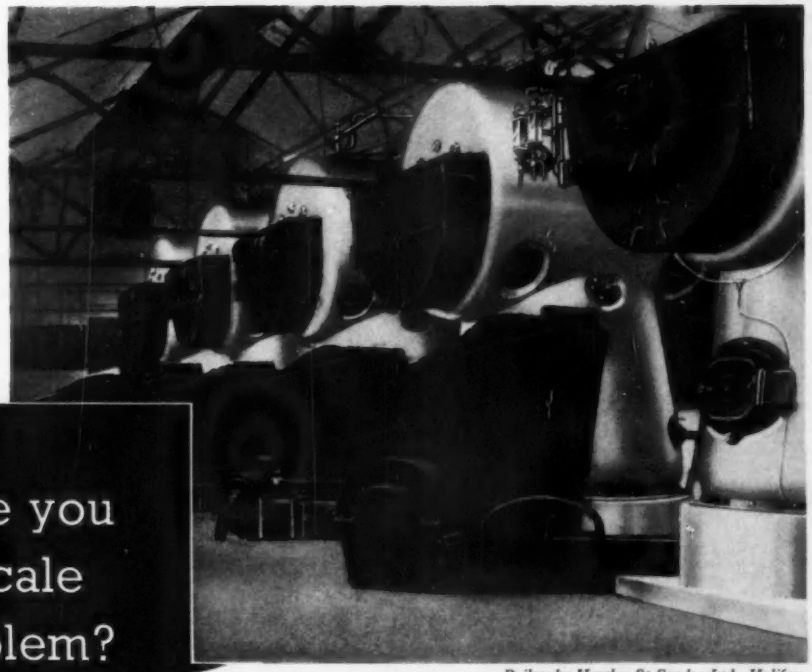

Boilers by Hartley & Sugden Ltd., Halifax.

* Have you a scale problem?

A section of Copper piping showing heavy scale deposit.

The same section after treatment with Starit.

Scale deposits on the interior of a boiler impose stresses in the metal and seriously impair the transfer of heat from the fuel to the water with the efficiency so vital for economical steam raising. Starit Solution effectively removes most types of scale from boilers, cleaning those awkward corners impossible to reach by hand and leaving the metal in a first class conducting state. The unique formulation of Starit ensures rapid attack on the scale whilst its action on the boiler plate is inhibited.

As there are certain cases where the scale is not susceptible to chemical attack we invite you to send us a sample, so that we can determine whether Starit is suitable for your particular problem. We also supply, on request, an informative booklet dealing with the many uses of Starit and the methods of applying it.

* solve it with **STARIT**

STARIT TRADE MARK

STARIT LIMITED · DARWEN · LANCS

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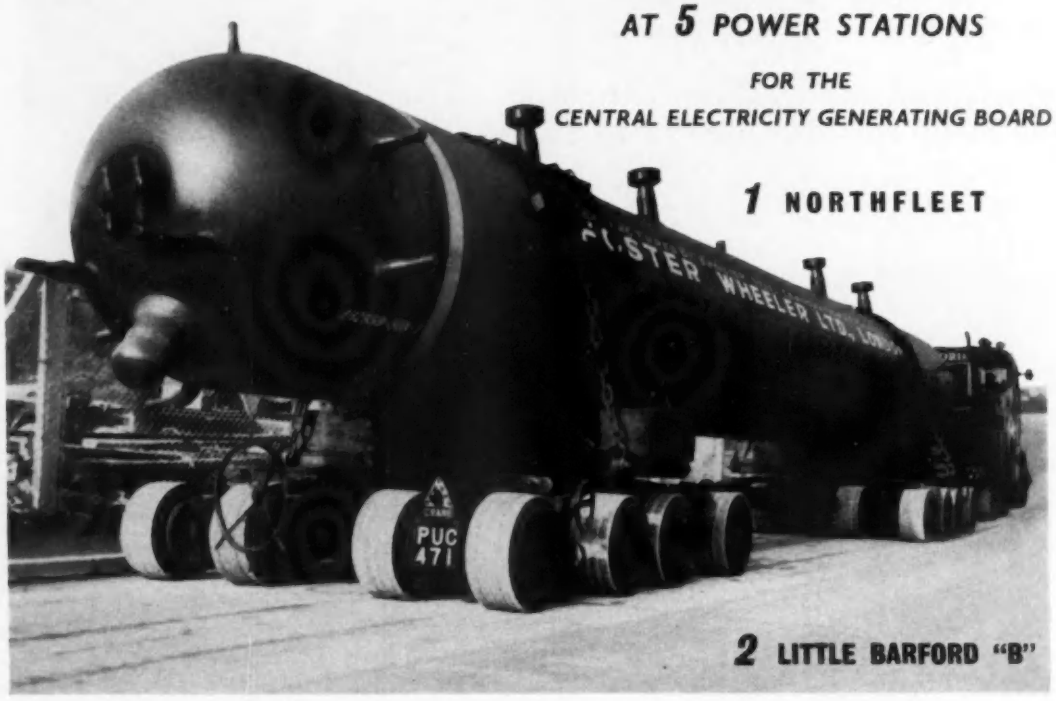
FOSTER WHEELER

WATER TUBE BOILERS

NOW BEING ERECTED
AT 5 POWER STATIONS
FOR THE
CENTRAL ELECTRICITY GENERATING BOARD



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2 LITTLE BARFORD "B"

3 ABERTHAW

4 DRAKELOW "B"

5 SPONDON "H"

Twenty-one boilers, with a combined maximum continuous rating of 14,120,000 lb. per hour, have been designed for the Central Electricity Generating Board by Foster Wheeler Limited, and are now being installed by them in five power stations. Since 1946, Foster Wheeler has been responsible for the design of no less than forty-eight boilers, totalling 21,050,000 lb. per hour maximum continuous rating, for thirteen C.E.G.B. power stations.

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FOSTER WHEELER LIMITED

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"*The Houseman Service*"

BY PETER SPITTLEHOUSE

The original of the above oil painting is in the Head Office of Houseman & Thompson Limited, together with the Artist's interpretation, a copy of which will be sent to anyone interested.

HOUSEMAN & THOMPSON LIMITED

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THINK IN TERMS OF Monolithic walls, roofs, hearths, etc., NOT brick by brick construction with its joint and other complications.

THINK IN TERMS OF High strengths before, during and after firing.

THINK IN TERMS OF Fast construction, smooth walls, easily constructed suspended roofs—all possible by concrete casting.

THINK IN TERMS OF Composite refractory and insulating structures cast in one piece—Refractory Concretes of varying refractoriness and thermal conductivity are easily made.

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Malleable Iron Annealing Oven with Refractory Concrete main arch and false arch cast in situ.

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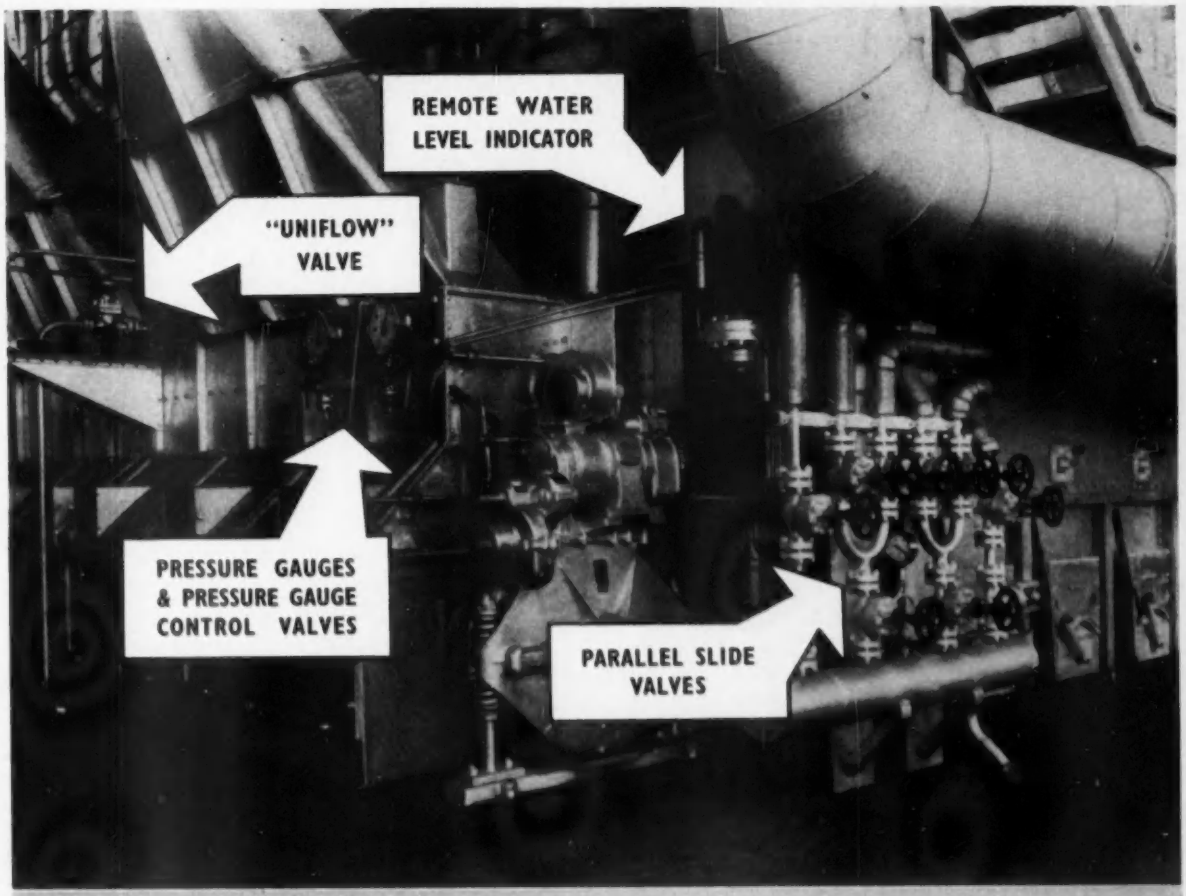

HOPKINSONS' VALVES AND BOILER MOUNTINGS

The illustration shows an installation with many typical Hopkinson valves and boiler mountings

Hopkinsons have specialised in high-pressure equipment, and have supplied the majority of the high pressure valves and boiler mountings to British power stations, as well as for many industrial plants

Hopkinsons' range of equipment, however, caters for all types of steam raising and usage, in addition to many other duties in industrial process work

HOPKINSONS LIMITED · HUDDERSFIELD

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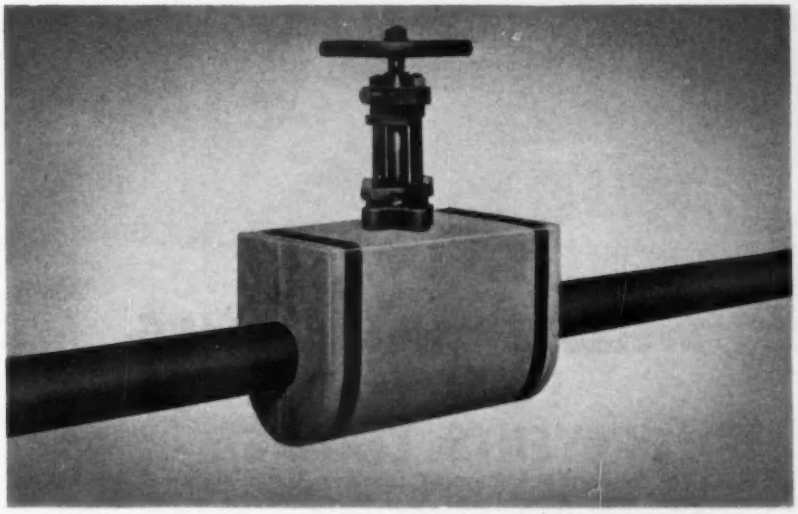
"It was, Gentlemen, a question of efficiency"

" . . . in the all-important matter of insulation the Building Committee was unanimous in its specification of VERSIL, the glass fibre. The qualities of this material are outstanding, especially when long-life has to be considered in conjunction with high efficiency. It would make life easy, gentlemen, if all decisions were as quickly made as this one!"

When you are concerned with a new building or additions to an existing building, and the problem is to keep heating where it's wanted, the advice and experience of Versil engineers in the Versil Contracts Department is available to you for the asking. You should contact Versil Limited, Rayner Mills, Liversedge, Yorks or telephone Cleckheaton 2571

Versil rigid sections provide a neat and efficient insulation for pipework of all kinds : preformed bends, tees and elbows are available as well as highly efficient units for the covering of flange and valve boxes. Versil rigid sections have the great advantage of being removable whenever inspections make this necessary.



What You Need Is Versil

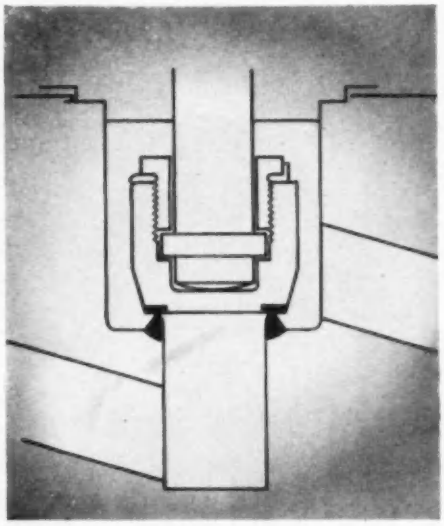
THE GLASS FIBRE INSULATION

REDUCE MAINTENANCE COSTS BY INSTALLING VALVES FITTED WITH

"HARD FACED"

SEATS AND VALVE HEADS

These Valves are giving long trouble-free service in land, marine and naval installations



"STELLITE" HARD FACING POSITIVELY PREVENTS LEAKAGE

The seat, shown opposite, is an integral welded "HARD FACE" deposit, accurately machined. The valve head is similarly deposited.

THE RESULTANT SEAL

(a) Offers utmost dependability to meet severe conditions,
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(c) is erosion and corrosion resistant, and
(d) eliminates seat replacements.

"HARD FACED" VALVES can be supplied ranging from ¼ in. bore, for pressures from 600 lb./sq. in. upwards, and temperatures up to 950 deg. F.

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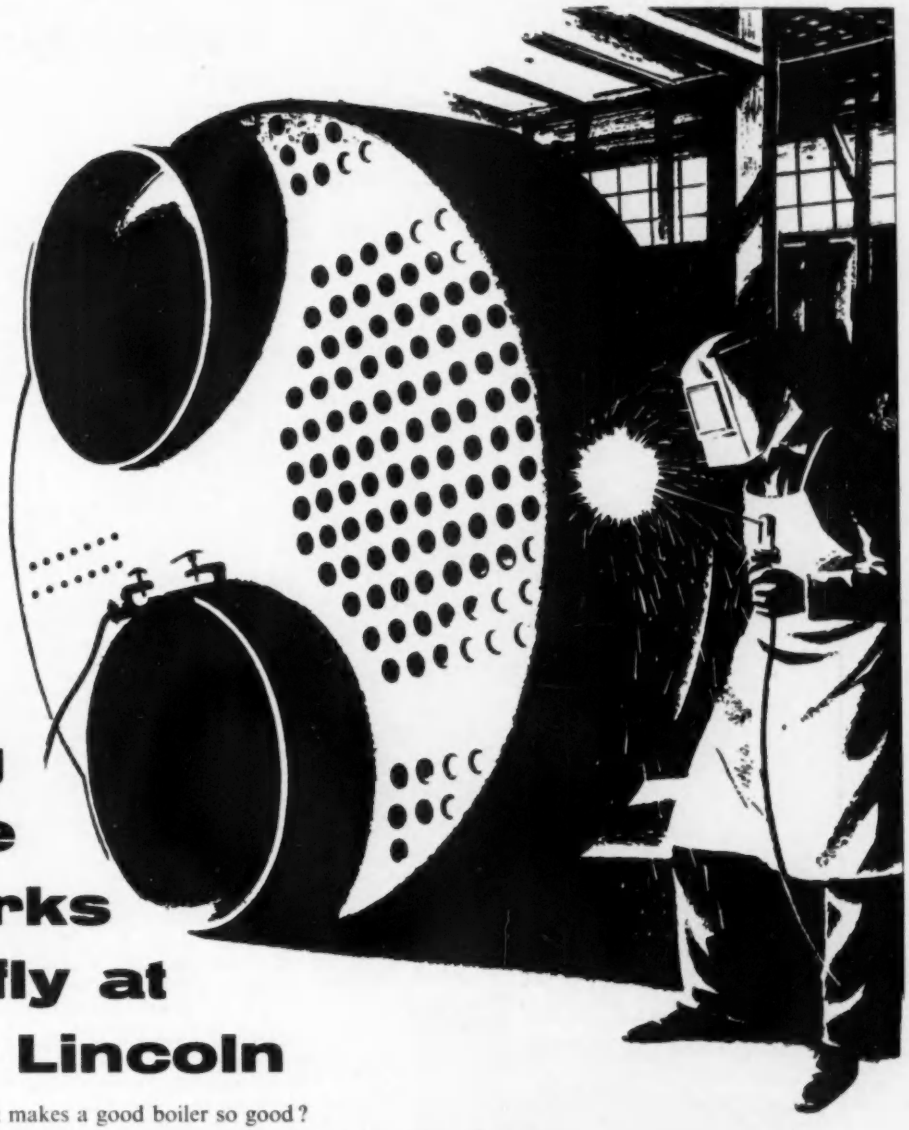
Suppliers of speciality valves to United Kingdom Atomic Energy Authority



Making the sparks fly at Lincoln

What makes a good boiler so good?
What's behind the name that's in the forefront of boiler design?
You can't really put the finger on any single aspect. It's a team job, a combined operation, a whole pack train of skills co-ordinated under the general heading 'know-how'.
It's *the Ruston touch.* Something that comes only after many years of supplying exactly the right type of boiler for a specific duty — whether it's steam raising or hot water supply.
It's the Ruston touch that gives you the Horizontal Thermax, the best three-pass wet back type boiler on the British market . . . the boiler that gives you 80% efficiency . . . the boiler that cuts operating costs to the bone and provides evaporations up to 17,500 lb. per hour.

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Also available as 'packaged' units with evaporations up to 6,000 lb. per hour.

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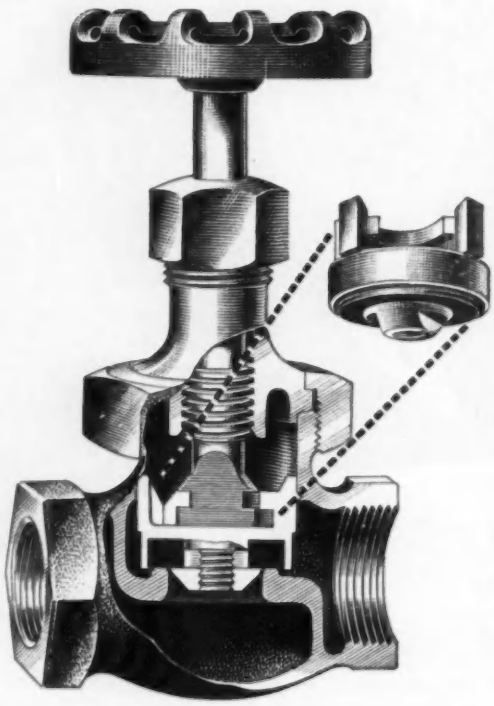

BULLETIN ON CRANE BRONZE GLOBE VALVES

...featuring the D7 with renewable disc holder and composition disc.

The renewable disc holder of the D7 makes it possible for the engineer to renew the disc on any size valve in this wide range quickly and easily. The replaced holder can afterwards be fitted with a new disc at the engineer's convenience. This valve is made to British Standard 2060 and is recommended for steam and hot water lines, and cold services such as water, oil, gas or air. When wide open, the valves can be repacked under pressure. They can be specially packed for petrol service.

Screwed or Flanged patterns available. Screwed British Standard Taper Threads - or to American Standards. Flanged in accordance with British Standard Tables 'D', 'E', 'F' or 'H' - or to American Standards.

Working pressures: (Valves with screwed ends) saturated steam up to 200 pounds. Cold services up to 400 pounds.
Sizes: Screwed - ¼" to 3". Flanged - ½" to 3".
Sizes 2½" and 3" have a bolted bonnet.

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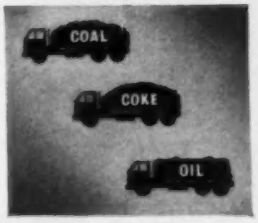

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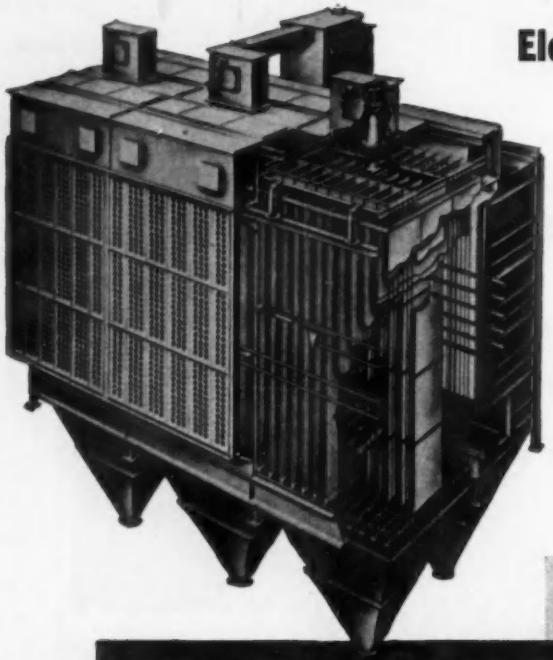

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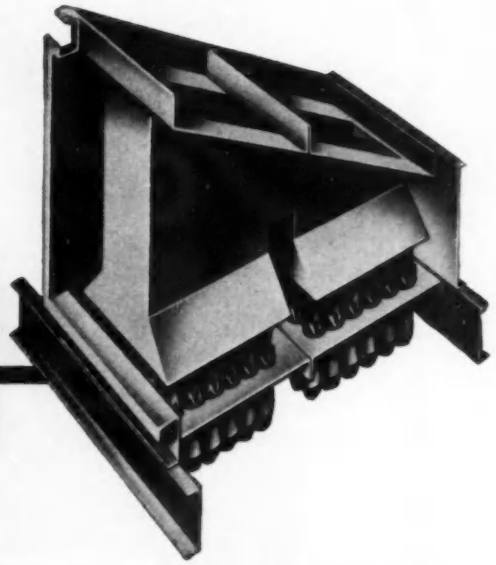
Made under licence from the Aerotec Corpn., U.S.A., these precipitators have an extremely high collection efficiency, low current consumption and many novel design features including screen-grid type collecting electrodes which minimise re-entrainment and consequent emission of dust. Manufactured in several combinations of width, height and length to suit available space in existing plants or most efficient usage of building volume in new constructions.



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Here is a dust collector which satisfies the ideal requirements of steam generator designers. It has a high collection efficiency at moderate resistance; maximum freedom from dust erosion; accessibility for maintenance and service; simple, low cost erection; flexibility of arrangement to meet space availability conditions. These collectors can be used in series with electrostatic precipitators and can be designed to match the precipitator inlet.

Induced & Forced Draught and Grit Arresting Fans

The product of over 75 years of experience, 'Tornado' induced and forced draught fans can handle any boiler draught requirements efficiently and reliably. The type A.R. aerofoil section backward bladed centrifugal fan, with peak efficiency of 90%, is only one of the many types (another is the combined induced draught and grit arrester) produced to deal with all classes of boilers from central heating to those in the largest power stations.

for CLEAN AIR

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in collaboration with Prat-Daniels (Stroud) Ltd., Whitecroft, Nailsworth, Gloucester

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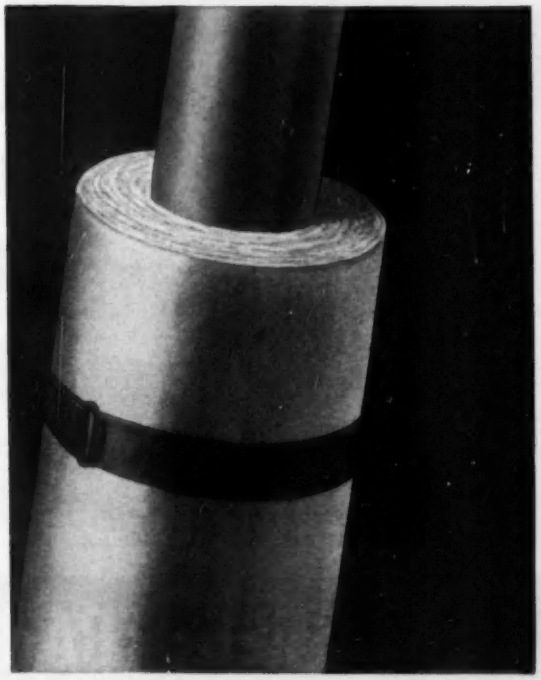
"I WAS A SNEAK"

—Master H. W. Pipe owns up

I was always in hot water—or rather hot water was always in me—when I left the boiler-room. But then I wandered about the school, improperly dressed. I used to dissipate my heat in draughty corridors. By the time I reached the dorm' radiators, I was as tepid as school tea!

But now I'm the blue-eyed boy: From outlet to delivery, I'm clad in Fibreglass Rigid Sections. So delightfully light, so superbly trim—no bagging at the knees and no losing degrees! My behaviour as a saver of fuel and a deliverer of hot water is earning A-plus Reports from all. But I'm *not* expecting a prize for Good Conduct. Because my Fibreglass jacket is about the world's poorest Conductor—of heat anyway!



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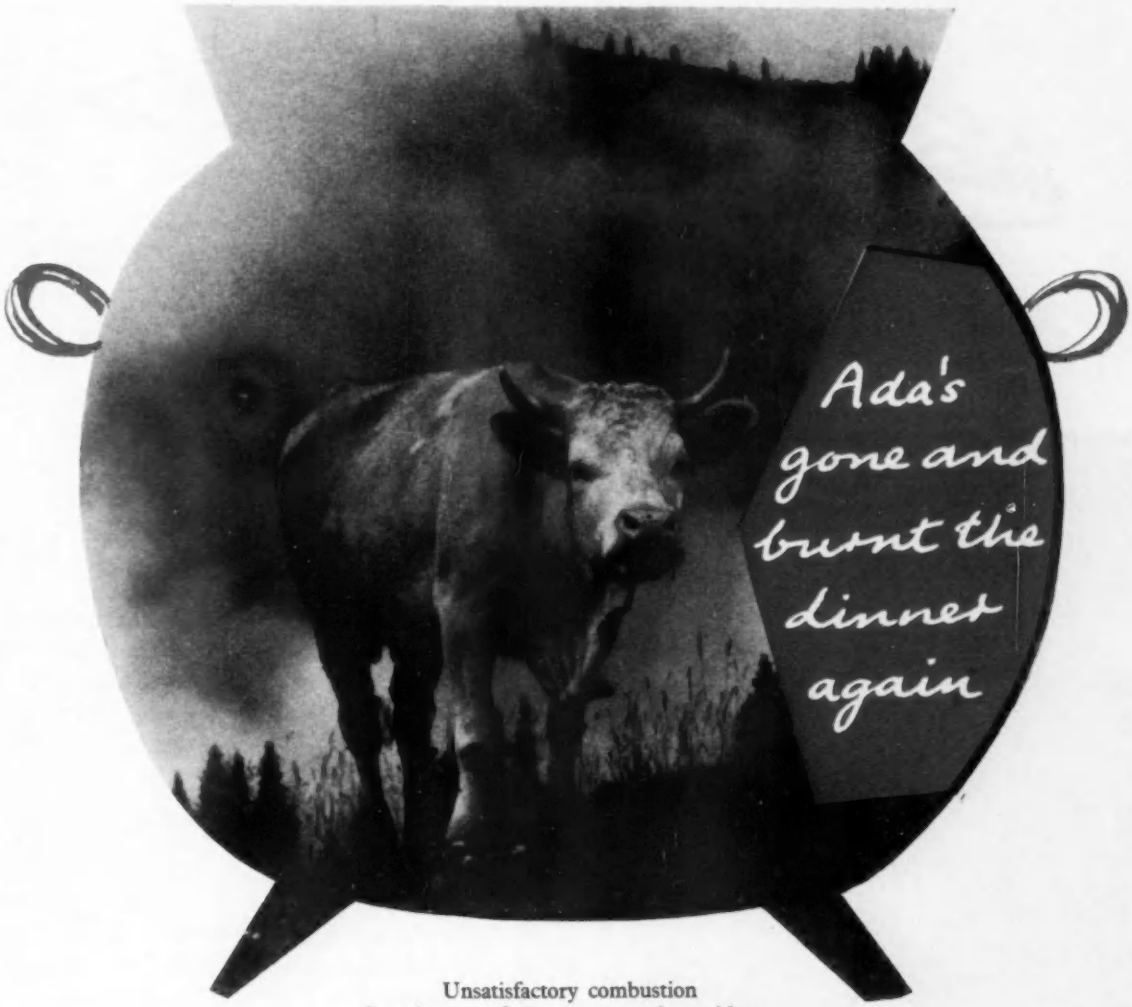

Unsatisfactory combustion
is only one of the steam-user's problems.
More than just good dinners may depend on getting it right.

Smoke pouring from factory chimneys used to be a symbol of prosperity. Nowadays, especially in oil-burning installations, it probably signifies erratic temperature control.

Correct fuel oil temperature is best ensured by heating the oil with low pressure steam which is automatically controlled by a Sarco temperature regulator.

The standard Sarco ' B ' valve can be fitted with a ' Type 21 ' thermostat, adjustable through a temperature range of 100° F. so that the grade of fuel oil can be varied at will.

Simple, self-acting and robust, this control will maintain correct temperature regardless of steam load, and will prevent overheating even on no load. Which surely makes sense in a busy world ?

Our Information Sheet No. 13 describes the proper temperature control, draining and air venting of oil-burning plant. The Clean Air Act gives it added value. Care for a free copy ?

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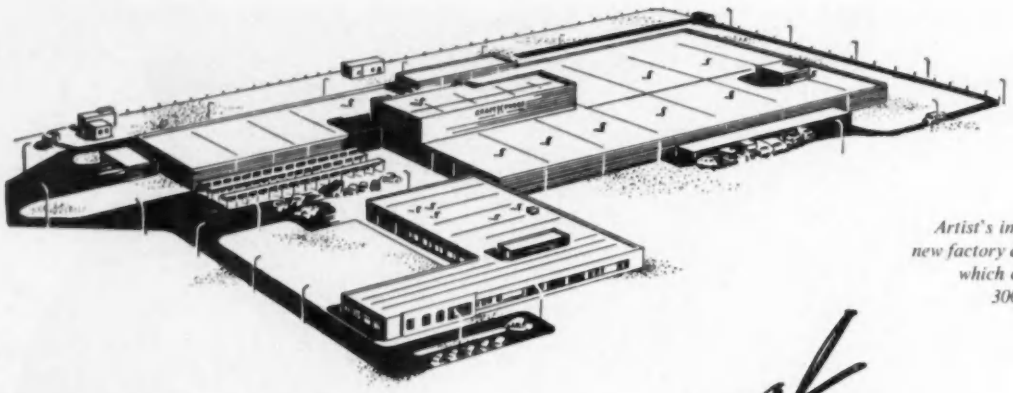
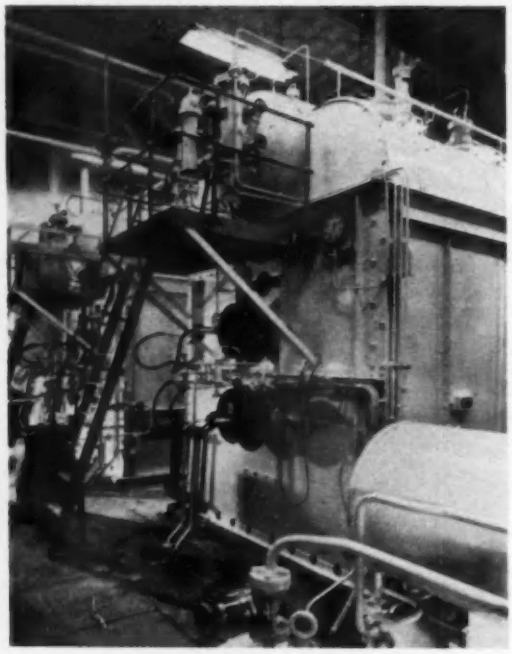


Artist's impression of new factory at Liverpool which covers some 300,000 sq. ft.



Illustrations by courtesy of Food Trades Review. The evaporative ratings available range from 2,300 to 6,600 lb/hr. from and at 212° F. with working pressures up to 625 lb/sq. in. with or without integral super-heaters.

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Boiler size	Heating Surface		Evaporation from & at 212°F		DIMENSIONS															
					A			B			F		L			S			T	
	sq. ft.	sq. m.	lb./hr	K/hr	ft.	in.	mm.	ft.	in.	mm.	in.	mm.	ft.	in.	mm.	ft.	in.	mm.	ft.	in.	mm.
200	1063	98·75	6600	3000	6	0	1830	6	0	1830	34	864	18	6	5640	8	3	2515	11	0	3350
250	1342	124·67	8250	3750	6	6	1980	6	0	1830	34	864	19	3	5870	8	9	2665	11	9	3580
300	1605	149·10	10000	4560	6	6	1980	6	8	2030	34	864	20	9	6325	8	9	2665	12	3	3735
350	1752	162·76	11500	5200	7	0	2135	6	8	2030	34	864	20	9	6325	9	3	2820	12	9	3885
400	2037	189·24	13250	6000	7	0	2135	7	5	2260	34	864	22	3	6780	9	3	2820	13	3	4040
500	2500	232·25	16500	7500	7	6	2285	7	9	2360	38	965	23	7	7190	9	9	2970	13	6	4115
600	3075	285·67	20000	9000	7	6	2285	8	1	2465	38	965	25	6	7770	9	9	2970	14	1	4293
700	3500	325·15	23000	10400	7	6	2285	9	8	2945	38	965	27	0	8230	9	9	2970	15	6	4725

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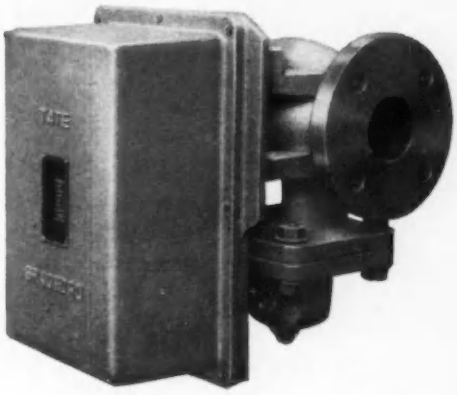

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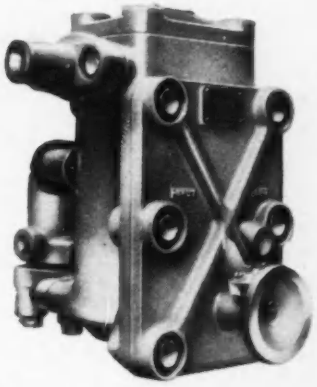

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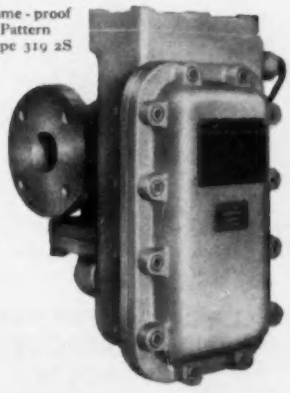

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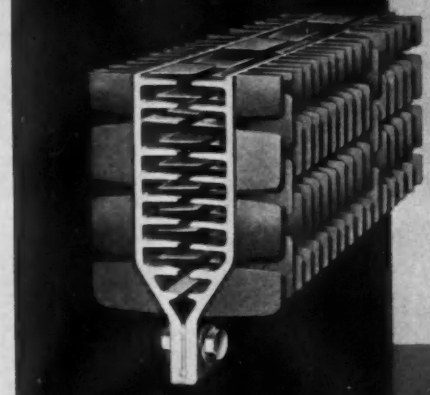

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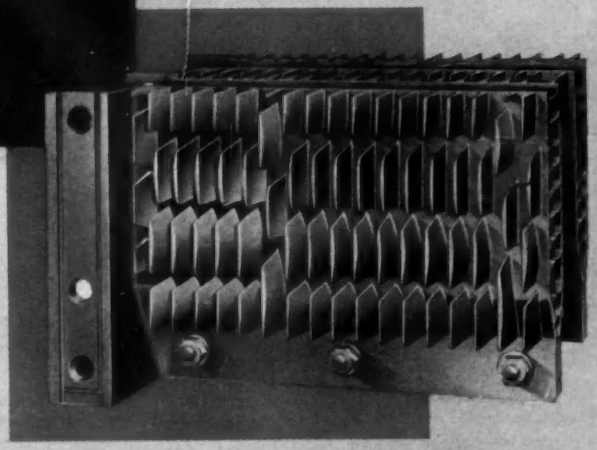

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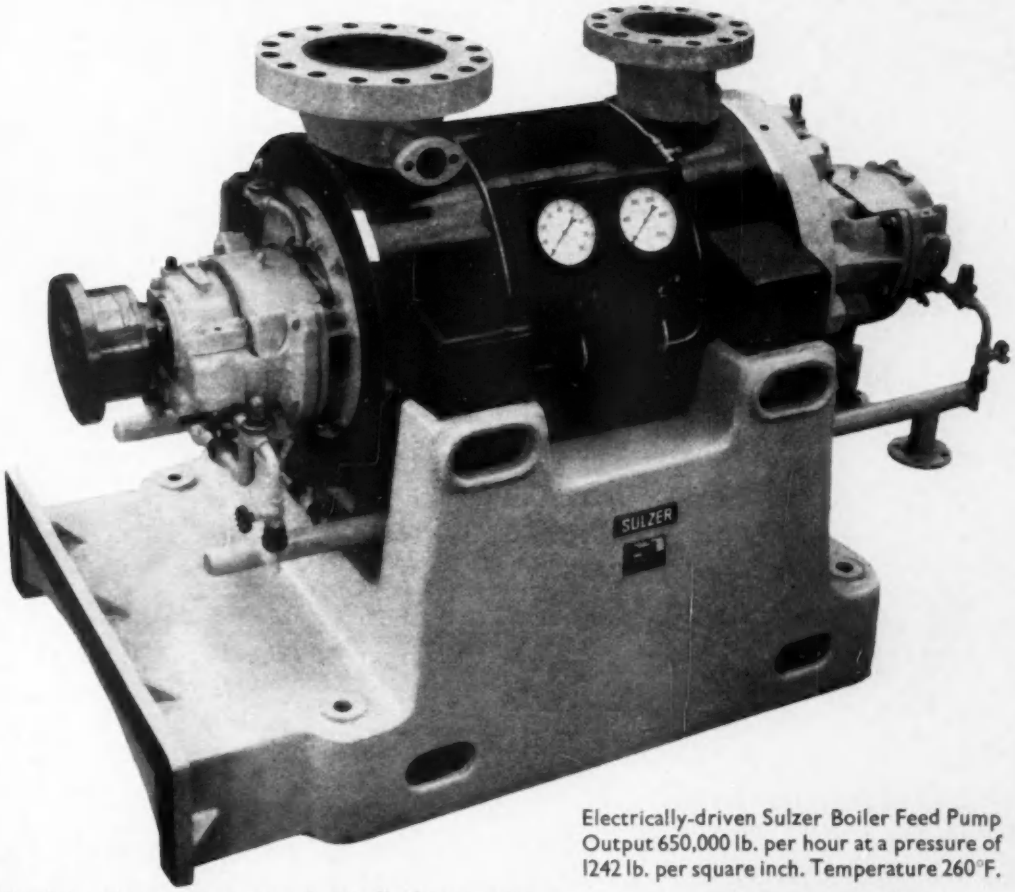

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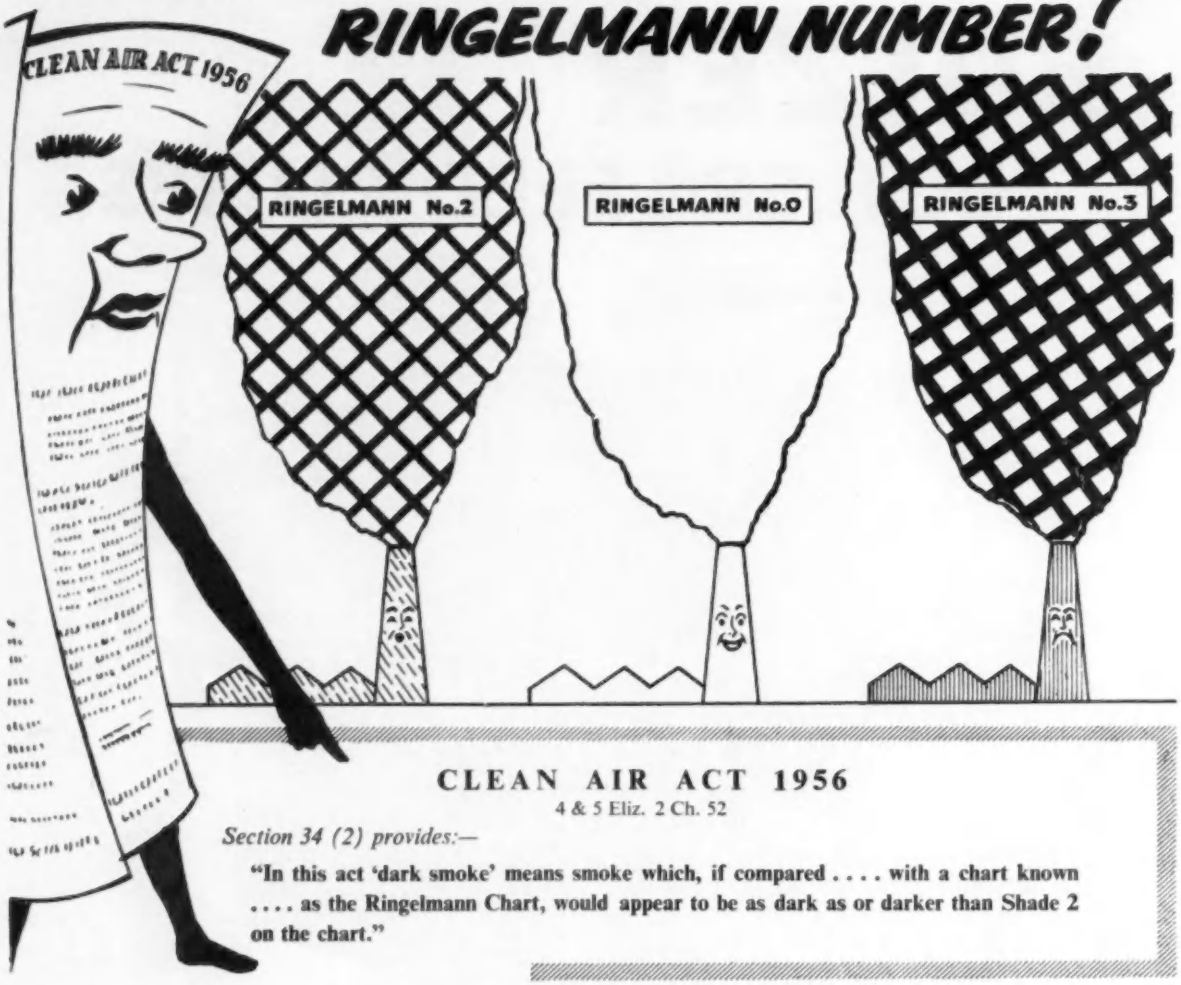

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Engineering and BOILER HOUSE REVIEW

THE OLDEST ESTABLISHED STEAM ENGINEERING PUBLICATION

MAY 1959

VOLUME 74. No. 5

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The Editor will be glad to receive and consider original contributions, correspondence, etc., of a suitable nature for publication. Stamped and addressed envelopes should be enclosed for the return of any matter considered unsuitable

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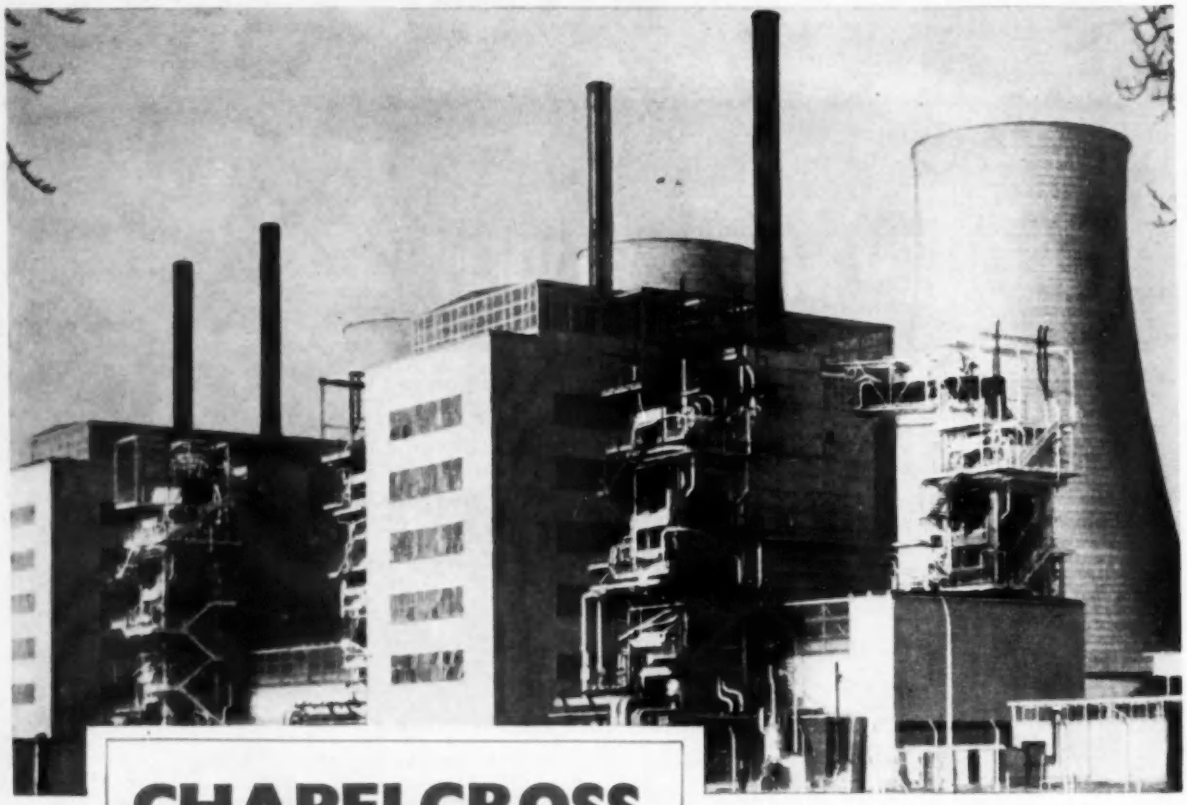
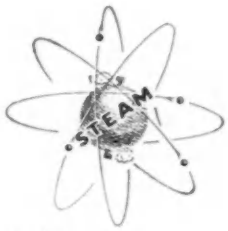
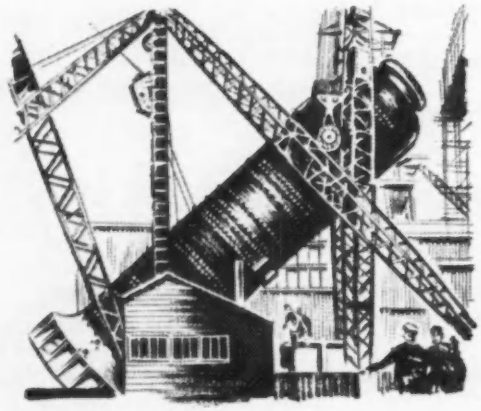


CHAPELCROSS

View at Chapelcross power station showing some of the 16 Babcock steam-raising units.

BABCOCK & WILCOX LIMITED have been responsible for the design, manufacture and installation of all the steam-raising plant for the new Chapelcross atomic power station. This plant, comprising **sixteen 80-feet high steam-raising units** (heat-exchangers) of the Babcock dual-pressure type, is essentially a duplicate of that at Calder Hall, which has been in successful service since 1956, for which also Babcock & Wilcox supplied all the sixteen steam-raising units. It is indeed a prototype of the steam-raising equipment for all the much larger atomic power stations now under construction in Great Britain, a programme in which Babcock & Wilcox are playing a major part. Babcock equipment at Chapelcross includes also a number of Goliath and other cranes, travelling platforms, etc. for spent-fuel handling and other services.





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Engineering and
BOILER HOUSE REVIEW

MAY 1959

VOLUME 74 No. 5

MECHANICAL ENGINEERING RESEARCH LABORATORY

THE Council for Scientific and Industrial Research has announced that in future the Mechanical Engineering Research Laboratory at East Kilbride, near Glasgow, will be known as the National Engineering Laboratory. This is because the Council considers it desirable to emphasise the national character of the Laboratory which is part of the Department of Scientific and Industrial Research organisation, and is financed from public funds. We understand that this change of title does not imply any modification in the field covered by the work of the Laboratory, which will continue to be concerned with an extensive range of problems concerning mechanical engineering. The Council has also decided to set up a " Steering Committee " to supervise the general programme of the work of the Laboratory. It is stated that, as a result of a recent review of the functions and activities of the Laboratory, the Council is convinced that, between the proper and reasonable activities of the universities and technical colleges on the one hand, and research associations and private and nationalised industry on the other, there is an important place for a national establishment for research in mechanical engineering, mainly supported by public funds. As we have previously mentioned in this journal, the object of the Laboratory is to establish the principles and extend the knowledge of mechanical engineering science so as to provide industry with the information it requires for the solution of its own particular problems.

In order, therefore, that its work may be focused on practical objectives of real value to industry, which may involve basic or applied research or, in suitable cases, development work, the Council has decided that the planning of the Laboratory's activities and the selection of research projects can best be under the control of a small number of men with a measure of executive authority. The new steering committee of five members will be under the chairmanship of Vice-Admiral Sir Frank Mason, K.C.B., M.I.Mech.E., etc., who is a member of the Research Council, and chairman of the outgoing Mechanical Engineering Research Board. In order to assist the director as the work of the Laboratory expands, and to improve and extend the links between the Laboratory and industry, two deputy directors have been appointed.

This new arrangement is obviously of considerable importance, and will enable mechanical engineering research, or rather the approach to it, to be regarded as something of an extension and growth of sound engineering practice aiming, by systematic study and experiment, at making new and valuable contributions to discovery, development and invention.

The importance which industry generally, and particularly the mechanical engineering industry, attaches to the ever-increasing necessity of properly organised research, has been strongly emphasised at recent engineering conferences. An outstanding example was given at the Nuclear Energy Conference organised by the Federation of British Industries, and held at Eastbourne a year ago. At this conference, Sir Edwin (now Lord) Plowden, chairman of the United Kingdom Atomic Energy Authority, gave some idea of the effort and cost of research which the Authority were putting into the development of a reactor system, from the stage when it ceases to be merely one among a number of concepts whose basic principles are being studied, until its capabilities can be fully tested on the completion of a reactor prototype. It was stated that, including appropriate support in technical assistance, laboratory facilities, irradiation testing and so on, the Authority spends approximately £10,000 per year for the work of each professionally qualified scientist or engineer employed on research. Thus, expressed in terms of money, the cost of developing a nuclear reactor system, excluding the major capital expenditure on the reactor experiment or reactor prototype or both, is likely to be of the order of £10 million.

It should be realised that the most important element in a research organisation, as in any mechanical engineering undertaking, is the staff and the quality thereof—particularly those members who are responsible for, and able to think a stage ahead of current practice. It is, perhaps, fortunate, that the normal technical and scientific training of mechanical engineers which demands and cultivates logical thought and continual reference to experiment, is conducive to versatility in the acquirement of knowledge in other fields, and that the practice of engineering, especially in the matter of design, which encourages a sense of responsibility in making decisions concerning these fields of knowledge, is adapted to develop the type of staff that would be sought for a mechanical engineering research organisation.

It is of interest to recall that there came into existence, on January 1st this year, the International Federation of Operational Research Societies. The initial membership of this body comprises the Operational Research Society (United Kingdom), the Operations Research Society of America and the Societe Francaise de Recherche Operationnelle. The principal object of the Federation is, of course, to assist the development of operational research as a unified science and to encourage its advancement in all nations of the world. Membership of the Federation is therefore open to national societies whose primary aim is to advance operational research and whose membership includes qualified scientists working in this field. Sir Charles Goodeve, who has pioneered the work of this country's Operational Research Society, has consented to act as the first secretary of the Federation.

Points and Pointers

SCOTLAND'S FIRST NUCLEAR POWER

Elsewhere in this issue we include an illustrated description of Scotland's first nuclear power station—at Chapelcross, in Dumfriesshire, and which is now providing electricity. The first of the four reactors there came into use for electricity generation on February 25th last. This reactor, which went critical (started working) in November, 1958, has concluded its testing and commissioning period, and steam has been produced for some time. With the completion of the steam circuit and turbo-alternator, the steam, which had previously been passed to a dump condenser, can now be fed to the turbines. The Chapelcross station, which will have a generating capacity of 184-MW and will, when all four reactors are completed, feed about 140-MW to the national grid, has been built by the United Kingdom Atomic Energy Authority as a dual purpose station to provide plutonium and electricity. Another nuclear power station is, of course, being built by the South of Scotland Electricity Board at Hunterston in Ayrshire, and will supply 320-MW to the grid. The construction of Chapelcross is under the control of Messrs. Merz & McLellan, acting as agents for the Atomic Energy Authority's Industrial Group. The official opening of the establishment by Col. Sir John Crabbe, O.B.E., M.C., T.D., Lord Lieutenant of Dumfriesshire, took place on Saturday, May 2nd, 1959, when the station was open to the public.

NEW THREE-YEAR PLAN FOR TECHNICAL EDUCATION

A new capital investment programme planned to cost £54 million for technical education in the three years after 1961, was announced on Wednesday, April 15th, by the Minister of Education. In a circular to local education authorities, the Minister says that in order to maintain the momentum of the advance in technical education, a building programme of £15 million will be approved for 1961-62, and that programmes for 1962-63 and 1963-64 will be provisionally set at the same figure. This total programme of £45 million is expected to involve consequential expenditure of £9 million on equipment. The £70 million building programme for the five-year period covered by the 1956 White Paper up to 1961 is reported to be progressing steadily. Building projects under this plan for new colleges or major extensions, now number 359, and in 1958 the amount of work started amounted to £15 million. Local education authorities will now be able to continue to plan their building work two years in advance. The new three-year programme will provide for:—(1) further increases in the output of advanced students in science and technology beyond the level of 15,000 a year which the plans announced in the White Paper were designed to make possible; (2) further expansion in educational provision for technicians and craftsmen to match the training opportunities which it is industry's task to provide for the growing number of young people who will be available for employment; (3) improving existing facilities in the colleges not only for teaching, but also for social and recreational purposes, including hostels. In the latter two years of the programme it is proposed to give special priority to building proposals for commercial education, on which the Minister hopes soon to announce his views in the light of the Report of the Advisory Committee on Education for Commerce. Details of the 1961-62 building programme will be announced as soon as possible.

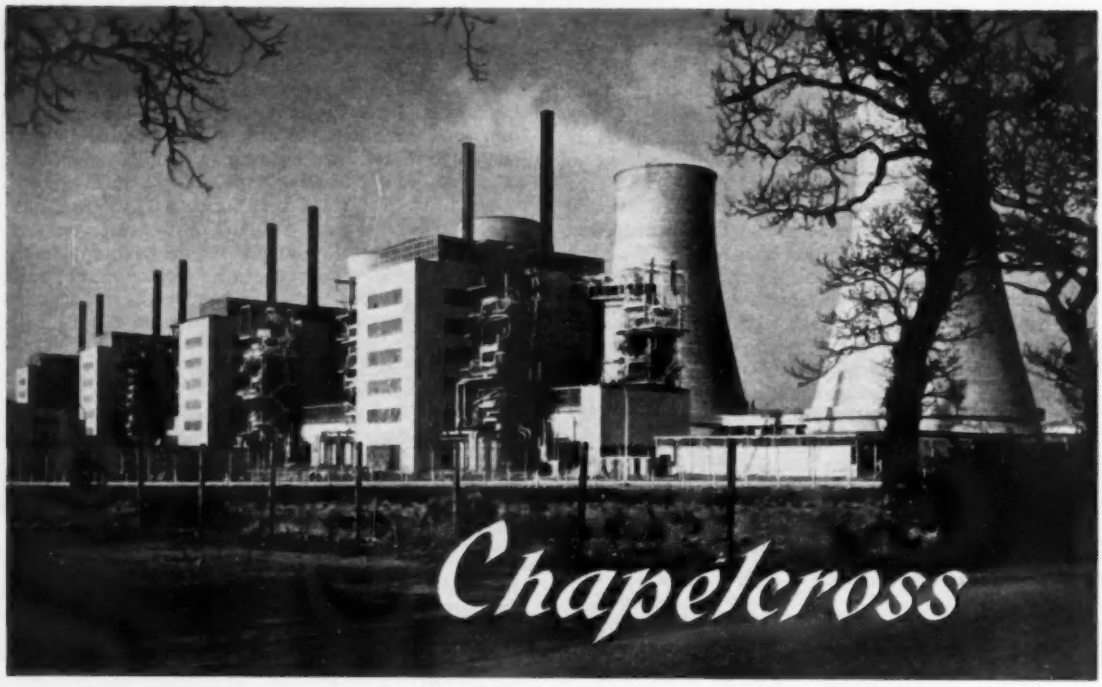
FEDERATION OF BRITISH INDUSTRIES

The annual general meeting of the Federation of British Industries was held in London on Wednesday, April 8th. At it, Mr. W. H. McFadzean, chairman and managing director of British Insulated Callender's Cables Limited, since 1954, was elected president in succession to Sir Hugh Beaver, who has held the office for two years. Mr. McFadzean was born in Stranraer and educated at Stranraer Academy and High School, and at Glasgow University, where he studied accountancy. He qualified as a chartered accountant in 1927, and worked with Chalmers Wade and Company from 1927 to 1932. He first joined British Insulated Cables Limited as accountant in 1932. By June, 1937, he had become financial secretary, and five years later, he was appointed executive manager (finance). On the amalgamation of British Insulated Cables Limited with Callender's Cables and Construction Co. Ltd., he was appointed to the board of the new company as executive director. In an address at the meeting, Sir Hugh Beaver emphasised the need to keep British industry competitive and efficient. He pointed out that 76 per cent., or more, of all the people "gainfully occupied" in this country were in industry or commerce; 4 per cent. were in agriculture. He added that this country exported about 40 per cent. of its production and that, though it could claim only about 8 per cent. of the total world manufactured production, it was still not far short of holding one-fifth of the published figures for world exports. These facts, Sir Hugh said, were a mark of this country's industrial greatness and of its achievement in the face of ever-increasing competition. He went on to suggest that in the world to-day and perhaps particularly in a country such as Britain, completely unable to support itself out of its own natural resources, the Government—every and any Government—must play a considerable part in industrial affairs. There must be, to a large degree, overall planning; it was not sufficient for the various parts of industry to be efficient, Sir Hugh remarked, industry must be, and must be able to be, an efficient and effective machine as a whole. Everything, Sir Hugh continued, pointed to a closely knit alliance between this country's free-enterprise competitive industry, on the one hand, and the Government on the other; by that, Sir Hugh explained, he meant the whole machinery of Government, and governments of whatever complexion. He went on to express the view that industry must accept that this was a "joint exercise" and that there was nothing now to be said for the old Victorian freedom of action even if that were still practicable.

WHITWORTH FOUNDATION SCHEME Mr. Geoffrey Lloyd, Minister of Education, has decided to double the value of the Whitworth Fellowship—for long the premier award in engineering—from £500 to £1,000 a year from 1960. He has also decided to alter the rules so that the award in future will be given not to newly qualified graduates, but to practising engineers who have shown themselves to be extremely able and likely to benefit from additional study and training. In a memorandum to local education authorities, the Minister says that he is taking these steps in order to meet the changed conditions since the Whitworth Foundation scheme was introduced, and to maintain the long-established prestige of the award. The original purpose of the scheme was to provide an opportunity for the student engineer of particular merit to obtain further qualifications and experience, but this has now been largely superseded by the growth of assistance from industry and public funds. Some of the most outstanding engineers this country has produced have been Whitworth men, and the records of the hundreds of men who have benefited by the foundation show that the majority of them have reached high positions in industry, education, or the public services, and have contributed substantially to the progress made in the field of engineering. From next year up to three Whitworth Fellowships of £1,000 a year will be offered. These may be supplemented by allowances for dependants and for travelling and subsistence. In addition, up to three Whitworth Exhibitions of £100 will be awarded to unsuccessful candidates whose work deserves recognition. Applicants must be over the age of 25 years and be in possession of a university degree in engineering, a Diploma in Technology (Engineering), a Higher National Diploma or a Higher National Certificate in Engineering with at least two distinctions, or a qualification approved by the Minister as of equivalent standard. They must have been subsequently engaged as practising engineers for not less than three years. Applications for the 1960 competition must be submitted to the Ministry of Education by July 31st, 1959. Full details are given in the new rules and conditions for the award of Whitworth Fellowships and Exhibitions obtainable from H.M.S.O., price 4d., or by post 6d.

F.B.I. OVERSEAS SCHOLARS The Fifth Annual Reunion Dinner of the F.B.I. Overseas Scholars was held at the Connaught Rooms on Tuesday, April 14th. The toast to the guests was proposed by Mr. W. H. McFadzean, the newly elected president of the Federation of British Industries and the response was made by Sir David Eccles, President of the Board of Trade. The dinner was attended by ambassadors or representatives from the majority of the countries from which the scholars come. Representatives from the Government, the firms participating in the scholarship scheme and a number of prominent industrialists also attended. The scholars, all of whom are young graduate engineers of high standing in their own countries, are spending two years in this country gaining practical experience with various industrial companies. They come from a large number of countries in Latin America, the Middle and Far East, and from many parts of the Commonwealth. The scholarships are being extended to new countries as the opportunity arises, and scholars from the Philippines and Thailand were present for the first time. The purpose behind the F.B.I. Overseas Scholarship Scheme is an attempt to see that engineers from developing countries have a full understanding and knowledge of British achievements, British practice and techniques and British equipment. The Scheme is reported to be beneficial to all concerned; it enables the scholar to become a fully-trained professional engineer; it provides technical assistance for his country; and it spreads information concerning the application of British engineering practice and equipment to the development problems of the countries concerned. By April 14th, 1959, 282 scholars had come to Britain from 117 Commonwealth countries, 129 from Latin American countries, and 36 from Middle and Far East countries. Of these 282 scholars, 91 were receiving training in Britain on April 14th, 1959, and 191 had returned home. In addition, 11 young engineering professors (10 from Latin-America and one from Ethiopia) had come to Britain under the joint F.B.I./British Council Scholarship Scheme for combined academic and practical training.

INTERNATIONAL COMBUSTION LIMITED The official opening of the new heavy engineering shop which International Combustion Limited have built and equipped at their works at Derby, took place on Friday, April 24th; the ceremony being performed by The Rt. Hon. Lord Mills, P.C., K.B.E., Minister of Power, and it was attended by about 200 guests. At the luncheon following the official opening, Sir James Reid Young, Chairman of Internationla Combustion (Holdings) Limited proposed the toast of the "Guests," and said that the provision and completion of the new shop marked the culmination of ten years' continuous expansion of the activities of International Combustion Limited and its associates. One can contrast this expansion in several ways, either by the steady increase in the buildings, plant and machinery which has occurred over the period, or by a comparison of the company's stock and work-in-progress, which was just over £2½ million in 1948 compared with a figure of almost £8½ million in 1958. The important and remarkable feature of this expansion is, that it has been entirely financed from the company's own resources. Replying on behalf of the guests, Lord Mills said:—It is no exaggeration to say that our future as an expanding industrial country depends very largely on the availability of adequate sources of power. It is a measure of the progress made when one recalls that in 1945 British turbo-alternator sets were mostly of about 30-MW capacity, and the design of 60-MW sets had only just begun. Today, sets of 200-MW and of 550-MW rating are being constructed for the C.E.G.B.—and their hosts that day (International Combustion Limited) were constructing the associated boiler plant for each of the first sets of these capacities. The Minister mentioned the entry of the company into the nuclear power field, and said he was interested to learn that the first order received for work in the new shop that he had just opened, was for the construction of heat-exchangers for the Windscale Advanced Graphite Reactor Experimental Unit.



WHEN, in June 1955, increased supplies of military plutonium were urgently required, it was decided to construct three new units of the Calder Hall type, each comprising two reactors and the necessary associated plant for the generation of electricity. One of these units was to be sited alongside the first Calder Hall station (Calder " A "), but the other two were to be located on the site of a disused airfield at Chapelcross, three miles north-east of Annan, Dumfriesshire. Construction work on the site began in October, 1955, and the generation of electricity was scheduled to commence on March 1st, 1959. Such were the accuracy of the planning and the efforts of the construction teams, that No. 1 reactor and its associated plant actually commenced electricity generation some days earlier, viz., on February 25th. The other three reactors will be commissioned at intervals throughout the remainder of this year. Although virtually a duplicate of Calder Hall (which it will be remembered was opened in October, 1956, by Her Majesty the Queen), various different constructional methods adopted, are enabling Chapelcross to be completed much more speedily. When in full production, the plant will be capable of feeding some 135-MW of electricity into the national grid system. Supervision of the construction of both the first and second Calder stations was by the constructional staff of the United Kingdom Atomic Energy Authority, but it was decided to enlist the services of Messrs. Merz and McLellan as consulting engineers for the power plant lay-out, services and civil engineering, and as construction agents for the whole Chapelcross project. With the agreement of the Authority, Merz and McLellan retained a firm of architects, L. J. Couves and Partners, who had worked with them on other projects, to deal on their behalf with the construction of the administration buildings, canteens and housing schemes associated with the project.

The Authority required the plant at Chapelcross to be built as quickly as possible, and therefore the minimum of alteration was to be made to the reactor designs which were already available for the first instalment of Calder Hall, then in process of construction. However, the lay-out of the Chapelcross plant differs essentially from that at Calder Hall, in that, while the latter was originally designed as a two-reactor station, the four Chapelcross reactors were built concurrently. This resulted in a rather different overall lay-out. The Authority placed the orders for the equipment of the reactors, the heat-exchangers, the blowers and the turbo-alternators, and carried out the inspection and progressing of this plant except for the turbo-alternators, which were entrusted to the consulting engineers. All other contracts, including those for the civil engineering, building and auxiliary plant, were placed by the consulting engineers as agents for the Authority.

The four reactors are grouped in one line as two " semi-detached " pairs, adjacent and parallel to the main concrete runway on the old airfield, while the four cooling towers are symmetrically arranged along a parallel line on the other side of the runway. The single turbine house is symmetrically placed in front (that is to the south) of the reactors, (not on the reactor line as at Calder), and the control room is located immediately adjacent to, and centrally with, the turbine house.

The urgency with which the plant both at Calder and Chapelcross was required, entailed very detailed programming and progressing to dove-tail the programme for Chapelcross with that of Calder Hall, and also to ensure that the work on site at Chapelcross and the delivery of

materials was so phased that no delays occurred because plant was delivered late or buildings and foundations were not completed on time. The consulting engineers were responsible for preparing all the detailed programmes for Chapelcross, within the framework of the general programme laid down by the Authority.

In view of the urgency of the completion of construction, it was decided to limit new design work on the reactors to a minimum. Thus, the differences between the reactors at Chapelcross and those at Calder are comparatively few. In fact, most of the component parts of the reactors have been bought as repeat orders from the same large number of manufacturers who supplied them at Calder. Major items, such as the reactor pressure vessels; gas-circulators, ductwork, and generating plant; and heat-exchangers, have been supplied again by Whessoe Limited, C. A. Parsons & Co. Ltd., and Babcock & Wilcox Limited, respectively.

The foundations for the Chapelcross reactors differ in character from those for the Calder reactors owing to the varying surface and rock-conditions. But changes in the design of the reactor buildings are slight. The abutting of long blower houses in pairs saves one gable-end per reactor. Furthermore, as one overhead travelling crane serves the double blower-house, the necessity for two cranes is eliminated.

One respect in which Chapelcross is novel, even compared with Calder Hall, is that provision had to be made on the site for storing irradiated fuel in order to allow it to decay sufficiently to permit safe transport to Windscale, where the processes of reconditioning the fuel commence. The consulting engineers were, therefore, called upon, under the general guidance of the Authority, to design cartridge-cooling ponds for this purpose, the design including the ponds and all the handling and decontamination equipment, the design of which latter is largely novel since the only previous experience had been on the handling equipment at Windscale.

Reactor pressure vessels

As with the Calder Hall plant, Whessoe Limited, Darlington, were responsible for the feasibility study for, and the design and construction of, the four reactor pressure vessels, each of which is cylindrical in shape, of fusion welded construction from 2-in. Lowtem high-notch-ductility "Conlo" steel plate made by The Consett Iron Co. Ltd., to Lloyd's Class I standard. It is a specially tough, easily weldable steel which has proved to be eminently suitable for requirements of such magnitude. Each pressure vessel is 37-ft. dia. by 70-ft. overall height, and consisting of five strakes, and top and bottom domes of semi-ellipsoidal form, the radii being 26-ft. for the crown and 8-ft. 3-in. for the knuckle.

The graphite moderator and associated equipment, weighing approximately 1,400 tons, is supported on a rectangular grid framework, the ends of which terminate on a circular ring girder. The grid itself is supported on 20 brackets equally spaced around the vessel, and welded to check plates which, in turn, are welded to the bottom dome. The load is transmitted directly through the vessel wall to an equal number of external support brackets welded to check plates directly opposite the inner brackets. As a result, the stresses which arise from the inner load are not directly added to the membrane stresses in the vessel caused by the internal pressure. The external brackets also take the total load of the vessel including charge tubes and sampling equipment, ducts, etc., which amounts to nearly 500 tons. The external brackets seat on the rolling surfaces of a number of columns made in the form of inverted "A" frames with 20 points of connection to the vessel and 10 to the foundations. The bases of the columns roll on flat plates mounted on grillages which rest on the concrete biological shield. Free radial movement of the vessel is permitted by rolling of the columns, whilst the "A" frame gives a very rigid support in the tangential direction, tilting being prevented by the stabilising force provided by the weight of the vessel itself, thus maintaining a constant vertical centre line. To avoid the heavy reinforcements which would have been necessary if the four 4-ft. 6-in. dia. inlet ducts had passed directly to the main vessel, a 12-ft. diameter cylindrical inlet dome was centrally positioned in the bottom head, the connection being a massive forged ring. The openings of the four outlet ducts were limited to 3-ft. 6-in. dia. to keep the stresses within acceptable limits, and the ducts were then diffused over a length of some 11-ft. to the normal dia. of 4-ft. 6-in. To avoid the use of reinforcing plates, 4½-in. thick shell plate was used to reduce the stress concentrations and to permit the maximum radiographic examination. One hundred and twelve charge tubes were set into the top dome. Great care was taken with the fitting of these tubes to meet the required tolerances. Additionally, there are smaller orifices for sampling equipment and thermocouple tubes, graphite growth measuring tubes and a viewing tube. Between the moderator and the pressure vessel, a seal is fitted to a ring beam above the upper face of the support grid to prevent the by-passing of the coolant channels by the gas. To assist the gas flow through the vessel, fairings were introduced in the inlet and outlet manifolds and below the grid support.

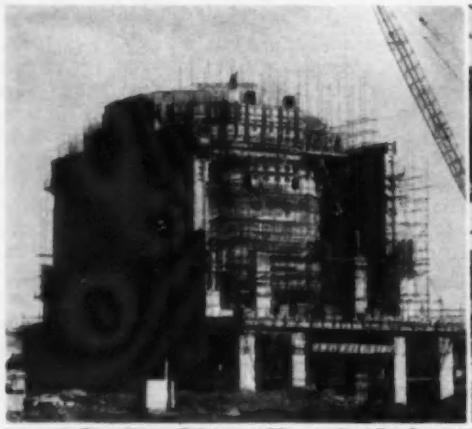
The pressure vessels were fabricated at site, following trial erection at the Whessoe works at Darlington. Each involved 1,700-ft. of welding, the butt welds being 100 per cent. radiographed. Magnetic crack-detection was employed to test all fillet welds. The bottom four strakes contained five plates, each 7-ft. 2-in. high by 23-ft. 4-in. approximately, while the top strake, 7-ft. 9-in. high, contained the 4½-in. thick reinforcing plates, outlet ducts and other branches. The top and bottom domes were constructed from 16 petal plates and 16 knuckle plates with, in the former case, a crown plate fabricated in halves. Prior to the lifting of the major sections of the vessels, the inlet ducts were lifted into place, followed by the inverted "A" frame columns and the external support brackets. These were followed by the inlet manifold and the main lifts. Thereafter welding of the sections took place, and following this the charge and irradiation tubes were fitted into position.

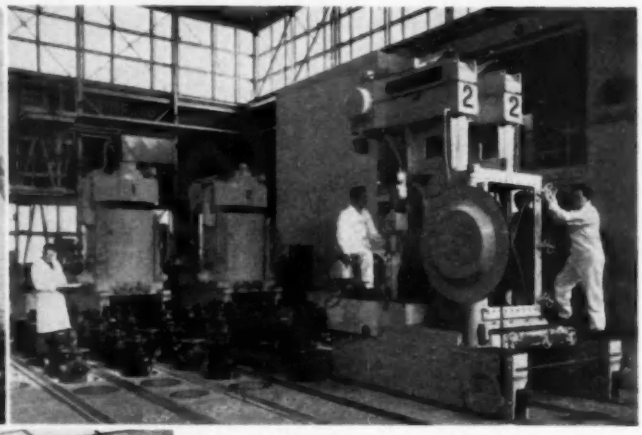
The insulation work on the reactor vessel was, as at Calder, carried out by The Darlington Insulation Co. Ltd., using Darlington Meta-Dextramite and Magnesia made by The Chemical & Insulating Co. Ltd.

Fuel charge and discharge equipment

The equipment for charging the two reactors with fuel elements, and for discharging, was designed and supplied by Strachan & Henshaw Limited, Bristol, and is similar to that installed by the same firm for

the Calder reactors. The fuel channels being vertical, with blind ends at the bottom, the insertion and removal of the elements is carried out through the top of the reactor, and, therefore, spent elements have to be removed before they can be replaced by new elements. Two mobile machines for charging and two for discharging are provided for each of the four reactors, these machines running on a series of parallel rail tracks on the charging floor, with a power-driven traverser for each reactor to transfer machines from one track to another, and so serve all channels. Each machine is electrically propelled and carries a winch unit for raising and lowering the elements, one at a time, by means of an electrically-operated grab. A wide range of controlled speed is provided from a full speed of 175 ft./min. with creep speeds at the extremities of motion. Each machine contains a circular rotating basket for carrying 24 elements, that is sufficient for four channels, and these are arranged vertically in compartments round the periphery, the basket being rotated one pitch at a time to bring successive elements or empty compartments over the charge tube in the charging floor which is in use. New elements are loaded by hand into the baskets in clean conditions in a fuel preparation room before being lifted into the charge machine, but baskets of spent elements are lowered directly from the discharge machines down a shielded well in a fixed position by a special hoist. In operation, the charge and discharge machines are practically identical, but the latter are much heavier, viz., about 60 tons in weight, since spent elements are radioactive and, therefore, the basket has to be enclosed in heavy shielding. Before charging or discharging can take place, the reactor has to be shut down and a charge tube prepared by fitting of a valve and gland assembly, withdrawal of a shield plug and insertion of the guide chute. This chute guides the element and grab between the reactor floor and the top of the core; it is rotatable, and has a hinged lower section so that from one charge tube, and with three different radial positions of the lower section, it can serve 16 channels. To handle the fittings for the charge tube and also the chutes, each reactor charging floor is served by a special electric overhead travelling-crane of 64-ft. span, with twin hoisting units of $7\frac{1}{2}$-tons and 1-ton capacity respectively, and, since it is necessary for all motions to be smoothly variable from full-speed down to a creep speed, the control is of the Ward Leonard type. These cranes were supplied by Strachan & Henshaw Limited, as were the chutes. A special well hoist is provided on each reactor for lowering the basket of spent elements out of the discharge machine down through a heavily-shielded well to ground level, where the basket is deposited into a heavy wheel-mounted cast-iron transit vessel containing water, in which it is completely immersed. A heavy shielding lid is then lowered on to the vessel, and, after it has been washed down, the shield doors to the loading chamber are





(Above, left). An early view of No. 1 reactor and its reinforced-concrete biological shield.

(Above). General view of charge floor of No. 1 reactor showing the fuel element charge and discharge machines.

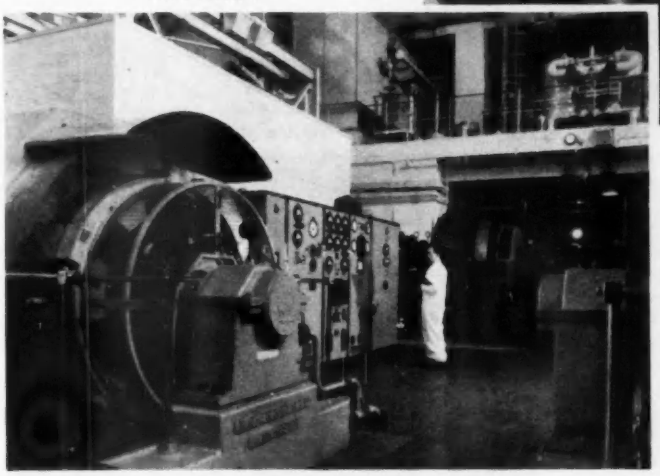
(Left). A recent view in the pile control room of No. 1 reactor.

opened and the vessel transported to the storage pond. Obviously, all the operations, up to the point of opening the door, have to be carried out by remote control from outside the chamber.

An important aspect of the use of nuclear energy in power stations is the control of the rate of production of heat in the reactor. Control is effected by the movement of vertical rods, which, by absorbing neutrons, control the rate at which fission takes place. The control rod system was developed by Metropolitan-Vickers for the U.K.A.E.A. over several years, and the present design provides failure to safety under all conditions combined with maximum reliability of operation. The actuating mechanisms, 60 of which have been supplied for each of the four reactors, combine the functions of control and shut-off as opposed to the separate control and shut-off rods of such reactors as BEPO Vertical operation of the rods permits the use of a gravity fall for shut-off. Controlled braking is used so that a high launching speed can be attained with slow touchdown. Each actuating mechanism is shielded from neutron bombardment and is designed to work in contact with the CO_2 coolant at a pressure of 100 lb./sq. in. Electrical connections are brought through the cast-steel housing to atmosphere. The control rod assembly weighs 130 lb., it has an operational travel of 21-ft. and is suspended by a special low-cobalt stainless-steel flexible cable, which is edge-wound between the side cheeks of a drum. Owing to the absence of oxygen and water vapour under operating conditions, a particularly difficult lubrication problem arises, and this has been solved by the use of a dry lubricant involving a molybdenum disulphide (MoS_2) treatment. The use of normal oils is undesirable, and graphite lubrication is unsuitable due to the lack of water vapour. The demands for safety and reliability often conflict, but it is essential to adhere to certain established principles for the safety of the reactor. The outstanding feature of the particular system described is that, while fulfilling all the principles of failure to safety, it provides maximum operational reliability. The equipment is similar to that manufactured by the company for Calder Hall.

(Right). General view of the precipitator units in the burst slag detection room associated with No. 1 reactor.

(Below). General view in the long blower house of No. 1 reactor.



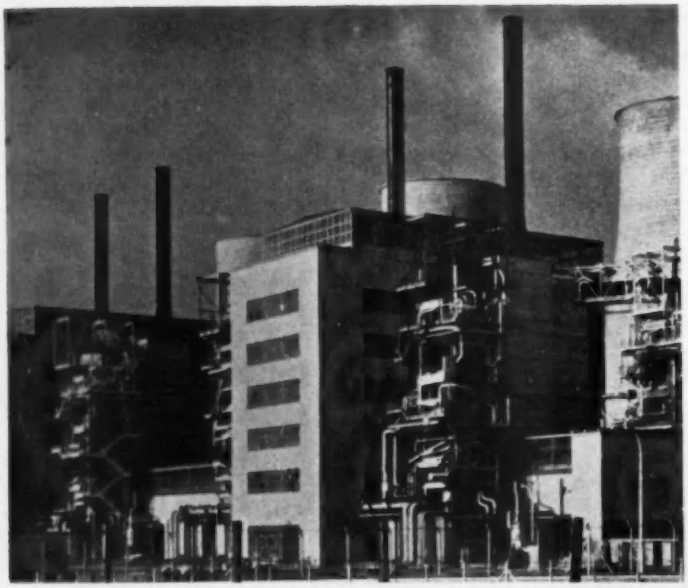
Gas-handling plant

A single carbon dioxide storage plant serves all four reactors—the plant being located at the rear of the turbine house. Five storage tanks, each of 20-tons capacity, are provided for the liquid, the pressure in them being maintained at approximately 300 lb./sq. in., by cooled coils in the gas space. When the tank pressure rises to 305 lb./sq. in., the unit refrigerator of each tank "cuts in" automatically, and "drops out" when the pressure falls to 295 lb./sq. in. The storage tanks are connected to a common liquid manifold which is arranged to feed a battery of six steam-heated evaporators, each of 3 tons/hr. capacity, and arranged in parallel. The plant is designed, as a maximum load, to charge two reactors at the same time at a rate of 8 tons/hr. each, but its normal duty is to supply the requisite small amount of carbon dioxide continuously demanded by the burst element detection gear of all working reactors and, when necessary, to "top-up" a working reactor.

Steam-raising equipment

Steam is generated by heat realised from each of the four reactors in four heat-exchangers or steam-raising units designed and supplied by Babcock & Wilcox Limited, and to the well-tried and successful Calder design. These 16 steam-generating units are based on a design employing the dual-pressure cycle proposed by Babcock & Wilcox following many years of intensive work by the company in association with the Ministry of Supply Atomic Energy Research Establishment at Harwell. Their design is especially significant as they are the prototype of the steam-raising equipment for the much larger nuclear power stations now being

constructed for the Central Electricity Generating Board. Each steam-raising unit embodies a high-pressure and a low-pressure system, in which approximately 77 per cent. of the steam is generated at 210 lb./sq. in., and 23 per cent. at 63 lb./sq. in. Both systems have superheating, evaporating and economiser sections, and each pressure system operates as an independent self-contained unit. Separate steam-and-water drums are provided, the drums being of the conventional type containing "Cyclone" steam and water separators and scrubbers. All drums, headers and pipework connections are mounted externally on the shell of the steam-raising unit. With the main purpose of reducing any possibility of leakage between the steam or water and the CO_2 coolant, all sections of the plant, other than the heat-transfer surfaces, are kept outside the gas circuit. In addition, the banks of heat-exchange elements inside the steam-raising units are inter-connected externally, the connecting tubes being brought out of the shell through thermal sleeves. The shell of the unit is approximately 80-ft. high and 17-ft. 6-in. dia. with a wall thickness of $1\frac{5}{16}$-in., and weighs, when empty, about 180 tons. Each shell is fabricated from 10 sections, consisting of the supporting skirt, two domed-heads and seven parallel sections. The shell sections were bent to shape in half-sections at the company's works at Renfrew, Scotland, and then fusion-welded along the longitudinal seams. The dome-ends were pressed from petal-shaped steel segments $1\frac{3}{4}$-in. thick, and after welding of the segments, and X-ray examination, the domed-ends were edge-turned in preparation for welding to the adjacent cylindrical sections, and finally completed by the welding-in of the large 6-ft. dia. gas-inlets and 4-ft. dia. outlets. The component sections of each unit were transported separately by road to a site workshop where they were circumferentially welded to form the unit pressure vessel. The site welds were examined by X-ray, and the shell was stress-relieved by high-frequency induction heating, and then subjected to a hydraulic test. The internal heat-exchange units, with the exception of the superheater, comprise banks of multi-loop studded tube elements which were lowered into the interior of the unit through the top gas-inlet opening. Extended heating surface of the stud-tube pattern, using elliptical-shaped studs, was adopted for these heat-exchange banks, providing a heating surface four times that of bare tube construction. The building-up and positioning of each bank demanded a high degree of cleanliness, and the work was carried out in an air-conditioned atmosphere. When completed, each steam-raising unit weighed approximately 480 tons in the dry state.



Dewrance & Co. Ltd. supplied some 32 sets of heat-exchanger valves, etc., comprising 3-in. Dewrance Consolidated "Maxiflow" safety-valves of the full-lift type; water-gauges with bi-colour illuminators; parallel-slide valves, isolating flap valves, screw-down non-return valves, etc. For the low-pressure circuit they supplied 16 sets, comprising 3-in. Dewrance safety-valves (high-lift type), parallel-slide valves and isolating valves. Dewrance equipment on the steam lines includes some sixty 10-in. to 14-in. parallel-slide valves, about

(Left). No. 1 reactor building, with the associated heat-exchangers supplied by Babcock & Wilcox Ltd.

(Below). High-pressure and low-pressure steam piping supplied by Stewarts & Lloyds Ltd., for conveying steam from No. 1 reactor heat-exchangers to the associated turbine.

250 CO_2 gas valves, including 3-in. and 8-in. parallel-slide valves with special stuffing boxes, and some 40 Consolidated safety release valves of the bellows type.

In addition to the heat-exchanger equipment, Babcock & Wilcox manufactured and supplied seven specially-designed cranes serving the cooling pond, for the transfer and disposal of spent fuel-element containers. This equipment, which includes basket and skip-handling cranes, travelling platforms and "flask" hoists, enables the spent fuel-elements to be taken to and from the cooling ponds for ultimate despatch to the fuel processing plant at the Windscale Works of the United Kingdom Atomic Energy Authority, where Babcock & Wilcox have also been responsible for the design and construction of cooling pond equipment and associated mechanical-handling gear.

Cooling pond handling equipment

This equipment was designed by Babcock & Wilcox to serve the cooling pond, for the handling of spent or damaged fuel-elements. This handling includes the recovering of the irradiated elements and their disposal into transportation flasks for processing at Windscale Works. The cranes supplied for this plant comprise a 50-ton electric overhead travelling crane which carries the standard type flasks loaded with spent fuel-elements from the pile cap to the loading and unloading bays of the two cooling ponds. These manipulating bays are serviced by two 1,600 lb. travelling platforms each fitted with a hydraulic ram and grab mechanism which removes the basket laden with spent fuel-elements from the flask and positions the basket ready for the transfer of the elements to a storage skip. Two 3½-ton skip-handling Goliath cranes, one to each pond, carry the filled baskets to the storage ponds where they are positioned in a pre-arranged pattern for storage. The skip-handling machine is a remote ram-operated grab mechanism arranged on a travelling gantry across each pond and fitted with variable speed gear for traversing. Photo-electric cells are used in both directions to indicate skip storage positions, and the ram gear is interlocked with this indication to prevent inadvertent release of the skip. A 1-ton basket-handling crane removes the empty basket from the pond, after transfer of the spent fuel-elements to the storage skip, and lowers it into a water spray decontamination tank. In addition to the normal storage crane facilities there is a 7½-ton electric overhead general purpose travelling crane which serves a separate pond containing special flasks for the storage of damaged fuel elements.

Boiler feed pumps

The six main boiler feed pumps were supplied by Sulzer Bros. (London) Ltd., and were manufactured at that company's Leeds works. (Incidentally, 12 smaller feed-pumps are used at Calder.) These Chapel-cross pumps are of the low temperature, multi-stage high-efficiency centrifugal type, each of 650,000 lb./hr. capacity, and designed to operate at pressures up to 355 lb./sq. in. The pumps are of the sectional casing foot-mounted type, instead of the Sulzer whole casing central line mounting as designed and used for high-temperature operation. Each pump is direct-coupled through flexible couplings to a 380 b.h.p. squirrel-cage motor running at 2,960 r.p.m.—each pump and motor being mounted on a combined base-plate.

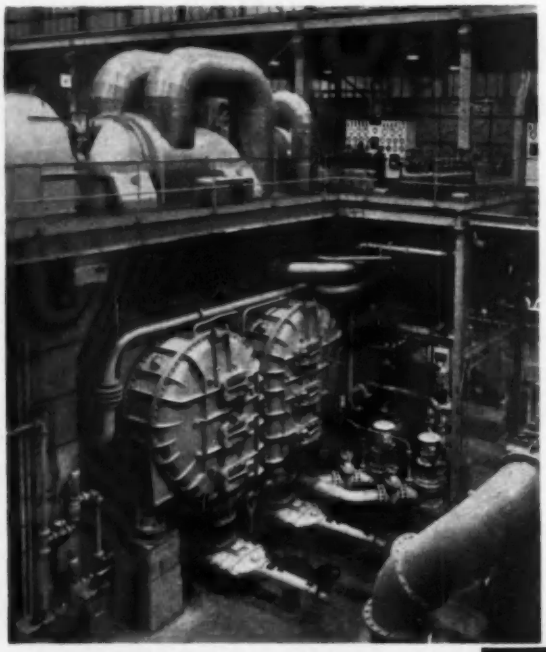
For the circulation of water through the secondary heat transfer-circuits, Hayward Tyler & Co. Ltd., Luton, supplied to the order of Babcock & Wilcox Limited 34 Hayward Tyler glandless electric circulating pumps and motor units. These pumps are almost identical with those which Hayward Tyler & Co. Ltd. supplied for the Calder plant. Sixteen of these pumps operate the low-pressure secondary circulating systems at 108 lb./sq. in., and 16 operate the high-pressure secondary circulating systems at 270 lb./sq. in. The remaining two pumps are supplied as standby units.

Apart from the absence of leakage, these pumps have several other interesting features. The inclusion of both pump and motor in a rigid pressure shell, mounted in a vertical position, eliminates problems of alignment. No baseplate is necessary, since the whole unit can be suspended from above, or carried by supporting the suction and discharge flanges. When the pump is at rest, the pressure on both ends of the shaft is equal and thus, when starting, there is no thrust bearing drag to overcome. Both thrust and journal bearings are of the tilting-pad type, employing respectively a disc and sleeves of plastic material running against stainless-steel pads. These bearings are water-lubricated, and require no attention whatever, and it is this feature, coupled with the absence of stuffing boxes, which allows these glandless pumps to achieve a running life of several years without maintenance or adjustment.

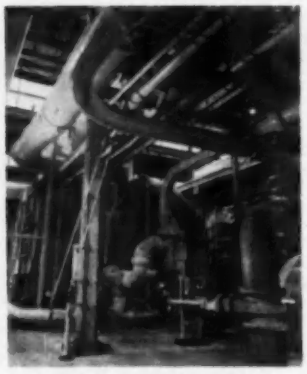
Valves and mountings were also supplied by Hopkinsons Limited, and these comprised parallel-slide valves ranging from ¾-in. to 28-in. bore; electrically-operated parallel-slide valves; desuperheating equipment; 20-in. "Deadweight" relief valves; isolating valves; automatic exhaust valves; "Nolos" steam traps; and centrifugal oil-purifiers.

Generating plant

The eight 23-MW turbo-generators, together with their associated condensing plant and auxiliaries, 16 gas-circulators, four dump-condensers and cooling-gas duct work were supplied by C. A. Parsons & Co. Ltd., all the plant being similar to that supplied by the company to Calder Hall. Two identical turbo-generators with condensing plant, two main line de-aerators and one dump-condenser with its associated desuperheaters form the main units working in conjunction with each reactor. Steam is supplied from the heat-exchangers at two conditions to each turbine, high-pressure steam at 185 deg. F., and 590 deg. F., and low-pressure steam at 38 lb./sq. in. and 340 deg. F., the steam after expansion in the turbine, being condensed in the surface condenser at a vacuum of 28.25-in. The turbines run at a speed of 3,000 r.p.m. and comprise a single-flow h.p. unit, solidly-coupled to a double-flow l.p. unit. The blading throughout each turbine is of the reaction type. As the full heat output from the reactor must be absorbed at all times, the turbines normally operate under steam pressure control; this being the most effective way of controlling the gas temperature circulation between the heat-exchangers and reactor. In the event of the reactor heat output exceeding that which can be absorbed by the turbines, the surplus steam is automatically passed to the dump-condenser, to be returned as feedwater to the feed system. The condensers are designed in accordance

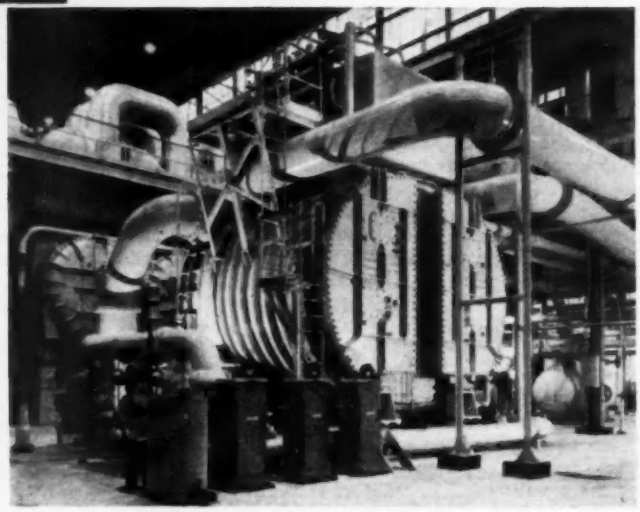


(Above). View in turbine house showing the C. A. Parsons No. 1 23-MW turbo-alternator set and its associated condensing plant.



(Right). One of the steam dump condensers, with No. 1 turbine in background.

(Left). A dump condenser with ancillary pipework in turbine house basement.



with modern power station practice, each condenser having a cooling surface of 32,500 sq. ft.

Dump condensers

To use any steam in excess of normal load requirements, and to allow for the possibility of the station being suddenly disconnected from the grid when on load, steam dump-condensers are provided, each being capable of taking the whole quantity of steam diverted from two loaded turbines. Primary desuperheaters using mechanically- and thermostatically-controlled spray-nozzles reduce the temperature of the steam entering the condenser to about 300 deg. F. Secondary desuperheaters are fitted in the top chamber of the condenser, each consisting of 12 nozzles which use condensate tapped from the extraction pump discharge. These desuperheaters reduce the temperature of the steam entering the condenser from 300 deg. F. to saturation point.

The generators are of Parsons standard design, each having a continuous maximum rating of 23-MW, 0.8 p.f., 11,500-volts, generating at a frequency of 50 c/s.

Gas-circulators

To remove the heat from each reactor, there are four motor-driven CO_2 gas-circulators. The mass flow of carbon dioxide through each reactor in normal operation is 1,964 lb./sec., and the inlet conditions, i.e., those at the circulator outlet are 100 lb./sq. in. and 140 deg. C. This duty is shared by the four circulators, each being designed for a mass flow of 500 lb./sec. The circulators are of the centrifugal-type employing an overhung design which minimises the gas-leakage problem by the use of only one shaft seal. This seal is of the oil-thrust collar-type used in hydrogen-cooled generators, but modified to cater for the higher pressures and temperatures. The driving motors for the circulators are d.c. machines, supplied from motor generator sets operating on the Ward Leonard system. This type of drive is reliable and stable at all speeds and gives a speed range of 10 : 1 which is necessary for starting and control purposes. The speed of the four circulators on each reactor can be remotely-controlled by a single operation in the main control room, and in addition, arrangements are made to ensure that all circulators operate at the same speed.

Gas ducts

The principal problems associated with the large diameter gas-ducts are those concerned with maintaining a leak-tight system whilst ensuring sufficient flexibility so that despite the considerable expansion differentials involved, the loads and moments on the reactor vessel, heat-exchangers and circulators to which they are connected, are kept to very low limits. To provide for this, bellows of the tied-type are employed. Where flexibility is required in more than one plane in a circuit a gimbal-type of bellows construction is used. Both the ducting and bellows units are fabricated complete with flanges.

Steam piping

Stewarts and Lloyds Limited were the main contractors for the design, supply, erection and welding of the pipework systems, including the whole of the high-pressure and low-pressure steam pipes from the steam generators to the turbo-alternators, together with the low-pressure dump steam connections from the main steam system, also all high and low-pressure feed pipes from the discharge of the boiler feed pumps in the turbine house to the steam generators. The high-pressure and low-pressure steam piping is 'hot finished seamless'; the sizes range from 15¼-in. to 3-in. bore, designed for a pressure of 275 lb./sq. in. at a temperature of 600 deg. F. The joints generally are of the butt-welded type with special seal weld flanges at valves. The low-pressure pipework associated with the dump condensers is 30-in. and 26-in. bore, made from hydraulic lap-welded pipes and designed for a pressure of 50 lb./sq. in. at a temperature of 600 deg. F. with standard flanged joints. The high and low-pressure feed pipework is 'hot-finished seamless' in sizes 8-in. to 3-in. bore, designed for a pressure of 410 lb./sq. in. at a temperature of 150 deg. F. with joints similar to those for the main steam services. The CO_2 pipework varies in sizes from 6-in. to 1½-in. and is made from electric resistance welded and hot-finished seamless steel pipes. The low-pressure section of the Stewarts and Lloyds contract includes all low-pressure water services in the turbine house associated with the circulating-water, town water and condensate systems, the exhaust steam pipework and the compressed-air pipework system. It also includes all drains and other similar auxiliary services in connection with the steam and feed pipework in the high-pressure section.

The thermal insulation of the high and low-pressure steam mains from the heat-exchangers to the turbines, was carried out by Versil Limited, who were also responsible for the insulation of the feed and auxiliary piping. Further insulation work by Versil Limited included the steam piping for the CO_2 plant and the CO_2 gas-piping. The material used was Versil flexible glass-fibre blankets to approved thicknesses, finished internally with wire-netting and "Versilex" hard-setting cement, and Versil flexible glass-fibre blankets enclosed in alochromed aluminium for the external work.

Feedwater supplies

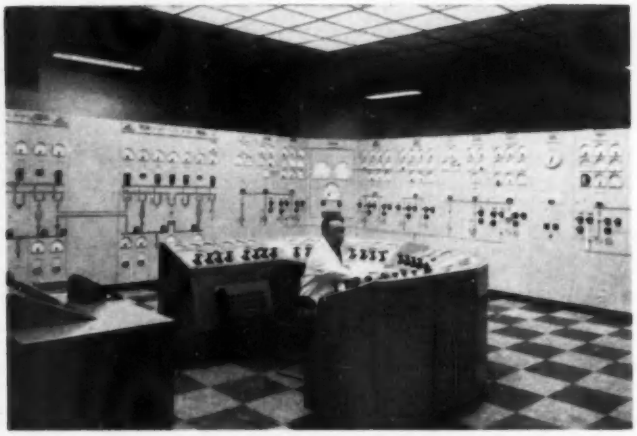
The feed and condensate systems are not arranged on the unit system, common headers being provided. The previously mentioned Sulzer main feed pumps, and the four standby d.c.-driven feedpumps are arranged in two groups—each group serving half the complete plant. Water for boiler make-up requirements is drawn from the Black Esk catchment of the Dumfriesshire County Council, and is treated in plant supplied by The Permutit Co. Ltd., who also supplied the plant for treating the reactor cooling-pond water. Demineralised water of exceptional purity for the boiler feed is provided by the section comprising two "starvation" units, a degasser and two mixed-bed "Deminrolit" units. The raw water supply is treated first in the "starvation" units. These are pressure vessels containing cation-exchange material operating on the hydrogen cycle. This material contains a preponderance of weak acid groups with the result that only the bicarbonate ions in the raw water are exchanged for hydrogen ions. The strong acid groups are unaffected by passage through this material, and the partially-treated water thus contains all the original sulphates, chlorides and nitrates, but practically no bicarbonates. Partial demineralising, equivalent to bicarbonate removal is therefore effected. During the breakdown of the temporary hardness and alkaline salts in the "starvation" units, free carbon dioxide is released. To avoid saturation of the anion-exchange material in the mixed-bed "Deminrolit" units, the water is taken from the "starvation" units and passed through the forced-draught degasser, where most of the carbon-dioxide is removed. At this stage the water still contains permanent hardness and other dissolved solids, the removal of which is carried out in the final mixed-bed "Deminrolit" treatment. The mixed-bed "Deminrolit" units are pressure vessels containing intimately mixed cation- and anion-exchange resins. In common with the "Starvation" units, to withstand the action of the acid regenerant, and to avoid the possibility of contaminating the treated water with even traces of metallic ions, the shells are rubber-lined. The water, as it passes through the units comes into contact with grains of cation and anion material alternatively, and is thus subjected to an almost infinite number of demineralising stages, and residual dissolved solids in the final water are extremely low.

The normal flow rate of the feedwater through the complete demineralising system is 10,000 gal./hr. The "starvation" units will treat over 100,000 gallons of water before requiring regeneration with sulphuric acid. The regeneration is preceded by backwashing the resin-bed to clean and regrade it. The mixed bed "Deminrolit" plant requires regenerating after treating 66,500 gallons. The bed is backwashed from the bottom of the cylinder to separate the two different kinds of materials. The anion-exchange materials are appreciably lighter than the cation resins and settle out on top leaving the bed in two distinct layers. Each of these layers is then regenerated, the anion-exchange material with caustic soda, and the cation-exchange material with sulphuric acid. The bed of ion-exchange material is then remixed by low-pressure air.

The treated water then passes (as at Calder) to make-up deaerators supplied by William Boby & Co. Ltd. This deaerator plant is rated to handle 2,000 gal./hr. of water, and to deaerate the water so that the oxygen content in the effluent does not exceed 0.03 cub, cm/litre. The deaerators are of the Boby pressure type, and designed to operate with a steam supply at 30/35 lb./sq. in. and 350 deg. F. The inlet water temperature varies between 60 and 100 deg. F. A heat-exchanger comprising four sections, and having a heating surface of 840 sq. ft., is provided for each deaerator, to give steam economy so that when the water entering the deaerator is at 60 deg. F., the temperature of the water leaving the deaerator does not exceed 120 deg. F. at the rated flow. A vent condenser of the shell and tube type is provided for each deaerator, and the extraction pumps, which were supplied by Mather & Platt Limited, are of the horizontal centrifugal type.

In the reactor cooling-pond section of the water-treatment plant, soft water for cooling the uranium fuel rods is provided by a Permutit ion-exchange water softener. When the uranium fuel rods become exhausted they are removed from the atomic reactor and lowered by skip into the cooling-pond. All water in this pond

and all make-up to it is passed through the softener. The raw water supply is admitted through the upper portion of the softener and uniformly distributed over the surface of the ion-exchange bed. It then flows evenly downwards through the material and the hardness forming elements, calcium and magnesium, are removed by ion-exchange, being replaced by non-scale-forming sodium salts. The softened water passes through the supporting layer of silex into the collecting system and into the cooling pond. The softener will treat up to 4,000 gal./hr. and 100,000 gallons between regenerations. Sodium chloride is used to regenerate the softener. As magnox alloy, of which the uranium fuel rod canisters are made, is particularly prone to corrosion it is essential that the pH of the cooling water is raised to, and kept at, the optimum figure. This is achieved by dosing caustic soda with a Permutit "E" type chemical feeder. A small amount of contamination of the water is inevitable, and for this reason a proportion of the cooling water is filtered through duplicate diatomaceous earth filters.



View in electrical power plant control room.

The circulating-water pumps which are located within the turbine house were supplied by W. H. Allen Sons & Co. Ltd., and are fully cross-connected on the discharge side, to supply the whole station. There are four Allen 48/48-in. vertical double-suction centrifugal pumps, each designed to deliver 50,000 gal./min. of water against a total head of 67-ft. when running at a speed of 490 r.p.m. Each pump is driven by a 1,225-h.p. Laurence Scott & Electromotors vertical, squirrel-cage, totally-enclosed motor mounted on the pumps, to which they are directly connected by means of a flexible coupling of the pin-and-bush type. The pump shaft rotates in one combined thrust-and-journal bearing, arranged outside at the top of the pump, and a grease-lubricated bearing fitted internally at the base of the pump.

BRITISH INSTRUMENTS DIRECTORY AND BUYERS' GUIDE

The latest edition of this comprehensive 600 page illustrated scientific and industrial instrumentation handbook has recently been published in co-operation with the Scientific Instrument Manufacturers' Association, by the United Science Press Limited, 9, Gough Square, London, E.C.4, price 2 gns. The guide covers scientific and industrial instrumentation for research and production in the following main fields:— measurement and control of temperature, pressure, humidity, flow, weight, texture, dimensions; inspection and gauge testing, manual and automatic; data processing, computers; optics, ophthalmics, navigation, meteorology, microscopy, astronomy, surveying and levelling; physics, mechanics, pneumatics, hydraulics and electrics; analysis; laboratory ware; atomics, electronics and nucleonics. The 10 main sections in the directory are: (1) Associations allied to the instrument industry. (2) British Standards Specifications. (3) Consultants, engineers for instrumentation schemes. (4) Manufacturers of prototypes and small batches. (5) Instruments and components with manufacturers. (6) Glossary in French, German, Spanish and English. (7) Addresses of manufacturers and their overseas agents. (8) Selected trade names. (9) Manufacturers' announcements. (10) Advertisements. The address of the Scientific Instrument Manufacturers' Association is 20, Queen Anne Street, London, W.1.

* * *

The Mechanical and Electrical Division of **Messrs. George Wimpey & Co. Ltd.** have recently been awarded a contract worth nearly £200,000 for the complete coal-handling plant at the 360-MW plant at Richborough Power Station, Kent, by the Central Electricity Generating Board. The plant, which has a capacity of 600 tons/hr., will receive local coal by drop bottom wagons, and will convey this to the generating station by belt conveyors, which incorporate automatic weighers, magnetic separators, screens, and also a radial slewing boom conveyor for forming piles to stock out coal by bulldozers. Reclaiming will be by bulldozer through vibrating grids into the system, and travelling paddle feeders will be used for transferring coal from underground bunkers to the conveying system. The keynote of the plant is automation and remote control, and a complete dust-collection system will be included, with offtakes at all dusty points.

* * *

Charrington, Gardner, Locket & Co. Ltd. announce the opening of their new North-West Oil Sales Division, with offices at Fanum House, York Street, Manchester. Charrington's, already sole distributors of Mobil Fuel Oils over a wide area embracing London, East Anglia and the Midlands, will now extend their fuel-oil marketing activities to cover the North West of England and North Wales. Supplies of all grades of Mobil Fuel Oils for industry and the home will be distributed in Charrington's own transport from Mobil Oil Company's new £1 million ocean terminal at Ellesmere Port, now nearing completion. The divisional sales manager appointed in charge of the new office is **Mr. A. E. Thomas,** M.I.H.V.E., M.R.S.H., until recently manager of Charrington's Heating Engineering Department in London.

* * *

The National Coal Board have appointed **Dr. J. Bronowski** as director-general of a new department to take charge of the development of new processes for treating coal and in particular of the development of new processes for making smokeless briquettes from small coal. (The department will be called the Process Development Department.) Dr. Bronowski has since 1950 been director of the Board's Coal Research Establishment at Stoke Orchard, where several new processes for briquetting and treating coal have been devised in the laboratory. A special drive is now in progress to bring these processes to the stage of commercial production. The production of coke, "Phurnacite," conventional briquettes and by-products will remain the responsibility of the Board's Carbonisation Department under its director-general, **Dr. R. J. Morley.** This department will also remain responsible for the development of premium smokeless fuels in conventional coke-ovens.

* * *

Mr. H. J. Tyler, purchasing officer of the London division of the Central Electricity Generating Board, has been appointed regional purchasing and contracts officer for the Eastern London and South Eastern Region.

Simplified Tablet Tests for Water Used in Steam Generation

By A. T. PALIN, B.Sc., Ph.D., F.R.I.C.

THE main purpose of the "British Standard Tests for Water used in Steam Generation," published in 1949, was to ensure as much uniformity as possible in the methods of making the tests and in the manner of expressing the results. The first tests to be published were described as control tests for which no laboratory was required. Nevertheless, it was emphasised that a limiting factor in the choice of these tests would be the skill and experience of the personnel, and it has to be admitted that the simplicity of the tests left much to be desired, especially where operators unskilled in chemical manipulation were concerned.

The present system of tablet tests has been developed to meet this need for the utmost simplicity, and consequently to give every possible encouragement to the regular application of the important control tests by boiler operators. The unique feature of the system is that, with one or two exceptions, all reagents for a given test are combined together in a single tablet of standardised weight so that the only apparatus required is a stoppered bottle for shaking the sample and the appropriate bottle of tablets. All expensive chemical apparatus, glassware, standard solutions, indicator solutions and the like are eliminated. While there are several more or less elaborate testing kits at present available, the new system is believed to be unsurpassed for simplicity of technique coupled with an accuracy quite adequate for all control purposes.

The general procedure consists of adding the tablets to the sample of water one at a time until the required colour change is obtained. Crushing the tablets is quite unnecessary, as ingredients are incorporated to give disintegration on shaking with the sample in the stoppered bottle. Where necessary, the tablets contain interference suppressors and also suitable foaming agents which permit absorption of colour in the foam layer, thus enabling end points to be determined even for dirty or discoloured samples. The tests themselves are based on established procedures—EDTA methods being used, for instance, for all hardness tests, also for sulphate—and call for no special comment. The colour changes are quite marked and the answer is obtained from the number of tablets required in each test with an appropriate allowance being made for overshooting the end point.

The degree of accuracy achieved, depends on the volume of sample and the tablet strength. To take, for example, the determination of boiler water hardness, the tablet strength is 2 p.p.m. where the volume used is 100 ml. The figure actually obtained, therefore, corresponds to the mid-point of a range extending over 2 p.p.m. Clearly the maximum error could, in the extreme cases, approach $\pm$ 1 p.p.m., the minimum error, of course, being zero. On an average, however, the error in this particular determination would be $\pm \frac{1}{2}$ p.p.m. which most operators would regard as highly satisfactory, especially in this instance where the application of the usual EDTA titration method to the determination of boiler water hardness has, in the past, been considered by some to give unreliable results.

Test	Colour change	Suitable for	Volume Taken ml.	Multiply number of tablets by	From this result deduct	Notes
pH VALUE	Depends on Indicator	R.S.B.	10 or 50	—	—	Free from residual chlorine interference. Only one tablet required per test. Match colours in Lovibond Comparator (10 ml.) or Nessleriser (50 ml.). (The latter is more suitable for low alkalinity waters.)
ALKALINITY (M) ...	Yellow to Bright Pink	R.S.B.	100	40	20	"Half-Strength" tablets also available.
ALKALINITY (P) ...	Blue to Yellow	R.S.B.	100	40	20	"Half-Strength" tablets also available.
ALKALINITY (P) $BaCl_2$	Blue to Yellow	B	100	40	20	One Alk. (P) $BaCl_2$ tablet required per test followed by Ordinary or "Half-Strength" Alk. (P) tablets.
HARDNESS	Disappearance of Red Tinge	R	100	20	10	
HARDNESS (BW) ...	Disappearance of Red Tinge	S.B.C.	100	2	1	Hardness (BW) tablets are suitable for Softened Waters and Condensates. For Boiler Waters of High Caustic Alkalinity the "Supplementary Buffer" tablets may be required.
CALCIUM HARDNESS	Pink to Violet	R.	100	20	10	Test also requires "Calcium Hardness Pellets No. 1."
CHLORIDE	Yellow to Reddish Brown	R.S.B.C.	100 10	10 100	10 100	Low sample volumes are generally required for Boiler Waters and high sample volumes for Condensates.
SULPHATE	Disappearance of Red Tinge	B.	5	200	Deduct this result from 2,800	One "Sulphate No. 1" tablet required for test followed by "Sulphate No. 2" tablets. Additional apparatus—one 5 ml. pipette. For sulphates over 2,000 p.p.m. use 2 ml. sample and multiply result by 2.5.

R—Raw Waters
S—Softened Waters
B—Boiler Waters
C—Condensates, Demineralised and Distilled Waters
(Detailed instructions for performing the tests are given on the bottle labels.)

The accompanying table gives a summary of the procedures in which for simplicity the volume taken has, for the most part, been shown as 100 ml. There is no difficulty, however, in using any other volume which in particular circumstances might be more suitable. Thus, when the results are very low, e.g., chlorides in condensates, it might be advantageous to take 200 ml. for increased accuracy. In the case of very high results, e.g., high caustic alkalinity in boiler waters, 50 ml. of sample would be quite adequate. It is only necessary to multiply the answer by the appropriate factor. For instance:—

when using 200 ml.—divide by two;
when using 50 ml.—multiply by two.

As a general formula for any sample volume the factors given for 100 ml. may be used, afterwards multiplying the result by $\frac{100}{V}$ where V is the volume actually taken.

Finally, it may be noted so far as the Alkalinity Tests are concerned, that "Half-Strength" tablets are available which may be used either to give increased accuracy in determining very low alkalinities or where it is desired to reduce the sample volumes for the tests. The results in all tests are given in the usually accepted standard units, i.e., all hardness and alkalinity figures as p.p.m. $CaCO_3$, chlorides as p.p.m. Cl from which, if required, a simple conversion factor gives NaCl or $CaCO_3$, and sulphate as p.p.m. Na_2SO_4.

Whilst the accuracy afforded by these simple tests will be adequate for ordinary control purposes, there may be occasions when it is desired to use this system to give results having an accuracy approaching that of the corresponding laboratory technique. This requires a modification involving a "back-titration" procedure carried out as follows: 100 ml. (or other suitable volume) of sample is measured but only about three-quarters of it poured into the stoppered shaking bottle. The tablets are added in the usual way until the required colour change is obtained. At this stage the remainder of the sample is gradually poured into the bottle with shaking until the colour just begins to turn back again. The volume of sample left unused in the measuring cylinder is noted, the result then being given by the following formula—

$$\text{Result} = \frac{\text{No. of Tablets Used} \times T \times 100}{(100 - V)}$$

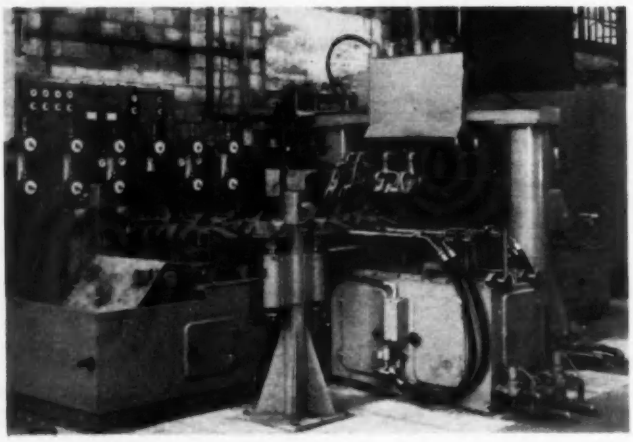
where T is the Tablet Value and V is the volume left in the cylinder. If the volume initially measured is different from 100 ml., then the 100 in the above formula must be replaced by the appropriate figure, and T also must have its appropriate value. This "back-titration" procedure is not applicable to the Sulphate Test.

Since no water treatment can be effective without some measure of control it is emphasised, by way of conclusion, that the primary aim in devising these simplified tablet tests has been to meet the engineer's requirements and to give a high degree of practical accuracy. Furthermore, in those organisations where laboratory facilities are available, the tests can be of value to the control chemist in ensuring that the prescribed treatment is being implemented at works level. Wilkinson & Simpson Limited, Manufacturing Chemists, Low Friar Street, Newcastle upon Tyne, 1, from whom full details may be obtained, collaborated in the development of the tabletted reagents, and have now undertaken to manufacture and supply all tablets required for the performance of the above tests.

Oxy-Town Gas Flame-Hardening

WE were recently invited to witness demonstrations of three applications of flame-hardening to components of large excavators manufactured by Ruston-Bucyrus Limited, Lincoln. The items of flame-hardening plant concerned all utilize town's gas with oxygen, and they were manufactured by Paul Ferd. Peddinghaus, Gevelsberg, Western Germany. The German company's distributors in this country are Surfard Limited, Alford House, 15, Wilton Road, London, S.W.1. Two of these machines were specially designed for Ruston-Bucyrus; the first to harden the excavator track links, and the second the internal gear and roller path of the truck frames on which the cabin and the excavating equipment rotate.

Parts of the track links that are subject to wear, are the four holes which bear on the track pin, two heavy lugs which take up the drive from the sprocket, and the roller path which runs on the trailer wheels. The machine designed for hardening these areas comprises a conveyor having eight stations. At the first station the link is accurately positioned by means of three adjustable bores and then retracted at the correct speed to give the required depth of hardening, the burner and quench supports. There is then an idle station, in order to allow space for later operations. The links then progress to the bore hardening position where the four holes or bearings are simultaneously hardened by means of the progressive method; the four burners and quenchers are pneumatically moved quickly to the further end of the bores and then retracted at the correct speed to give the required depth of hardening, the burner and quench unit being integral. A second idle station follows,



The Peddinghaus machine for flame-hardening the bores, lugs and roller-path of excavator track links.

and then the links are positioned for the lugs to be hardened by the spot method, in which the part to be treated is heated to the hardening temperature and quenched by spray quenches ; as the track link is moved to the correct position the conveyor stops and the specially shaped, water-cooled burners, which are pneumatically driven, are shifted horizontally to the heating position, where they descend over the lugs and are ignited from a pilot flame. On reaching the required temperature the burners are displaced by spray quenches which operate for a predetermined period. A further idle station is included at this stage, prior to the seventh station where the roller path is hardened by the progressive method, the quenches being situated just behind the burners ; here the link remains stationary, while the burner and quench assembly moves over the length to be hardened at the correct speed to ensure the desired depth of hardening. The final station is for unloading. At each station a photoelectric device ensures that the burners cannot be ignited unless the component is in position. The various operations are controlled by a pre-set programme selector. The links treated on this machine weigh from 4 to 7-cwt., and the time taken for the entire flame-hardening process is approximately 5 min.

With the machine for hardening the internal gear and roller path of truck frames, the teeth of the gear are hardened by the progressive method, the burners, to which water spray quenches are attached, rising over the length of the tooth—both flanks of the tooth being treated simultaneously. For the roller path the progressive method is again used, but in this case the burners and quenches remain stationary, while the component rotates. The speed of rotation is determined by a " Milliscope " automatic temperature control, in order to maintain a constant pre-set temperature.

The third machine has only recently been installed at the Ruston-Bucyrus works, and is the first in this country to flame-harden large gears by the spinning method. The machine, which can handle gears up to 40-in. dia., and with a tooth width of 4-in. comprises a tank in which the quenching oil is contained, at the centre of which a rotatable spindle is situated and on this the gear is supported horizontally by means of an adaptor. A number of oxy-town gas burners are arranged around the circumference of the gear. Two " Milliscope " automatic temperature controls are provided, one set tangentially to measure the temperature of the tip of the tooth, whilst the other is set radially to pick up the temperature at the root of the tooth. The gear is rotated between the burners by means of the spindle and when the tips of the teeth reach the hardening temperature, the oxygen is automatically reduced by a pulsating relay from the first " Milliscope " so as to prevent overheating, thus allowing the remaining part of the tooth to reach the pre-set hardening temperature. When this figure is obtained, the burners are automatically extinguished and the gear lowered into the quenching oil. A flow of compressed air is directed across the surface of the quenching medium in order to eliminate the possibility of igniting the oil. A built-in cooling device, coupled with an electric thermometer, maintains the oil at the required temperature. This thermometer, by means of a two-way switch, indicates the heat of the quenching oil and the water flowing through the heat-exchanger of the cooling equipment, so that the flow of water may be kept to the minimum consistent with the maximum desirable temperature of the oil. The heating time to harden a spur gear 39-in. in dia., having 124 teeth of 4 DP and a width of 4-in., is approximately 20 min., if hardening to the root is required.

NEW BOOKS

"Fluid Pressure Mechanisms," *by H. G. Conway, M.A. M.I.Mech.E., F.R.Ae.S. Second edition,* 1958. 235 *pages ; type area* 4½*-in.* × 6¾*-in. ; 182 line drawings. Published by Sir Isaac Pitman & Sons Ltd., London. Price* 32*s.* 6*d. net.*

This book deals with the mechanism of fluid pressure equipment and systems—that is, hydraulic and pneumatic machinery. It is not concerned with detail design or constructional features of the equipment, but with the essential principle of the various devices, how they work and how they differ from each other. The scope of the book covers hydraulic pneumatic and compressed gas systems of high, medium and in some instances low pressure. Since the book was first published in 1949, considerable development has taken place, and the text matter has therefore been revised. Some 60 new diagrams have been introduced as well as new material on slide valves, jacks with force limitation, special couplings, three-position jack systems, and synchronisation systems. In addition there has been a substantial revision of the chapter dealing with servo systems.

"Fundamentals of Boiler House Technique," by *P. D. Dehnel, A.M.I.Mech.E., A.M.Inst.F., lecturer in fuel and combustion engineering, Mechanical Engineering Department, Borough Polytechnic, London.* 164 *pages ; type area* 4¼*-in.* × 7*-in. ;* 30 *line drawings ;* 14 *half-tones. Published by Hutchinson & Co. (Publishers) Ltd.,* 178-202, *Great Portland Street, London, W.*1. *Price* 25*s. net.*

This book is intended for students requiring a knowledge of fuel and combustion engineering, as applied to boiler work, but it should also prove of interest to all those concerned with the efficient use of fuel. The many aspects of boiler house technique are dealt with, and sections are devoted to boiler auxiliaries, fuels, draught, combustion, water-treatment, smoke abatement, boiler testing and efficiency tests. Both the descriptive side, and the calculations that are required for a study of the subject are included. A logical sequence of presentation has been aimed at, but as each chapter is reasonably self-contained, it can be studied independently of the others. Worked examples, where applicable, have been given, and graded problems are included at the end of each chapter. Under the heading " Fuel and Flue Gas Testing," typical experimental work has been laid out in a simplified manner ; such experimental work provides an invaluable aid in any course of study in this subject. Many of the problems have been taken from the Boiler House Practice and Heat Generation examinations set by the Mechanical Engineering department of the Borough Polytechnic, London.

"Analysis of Pipe Structures for Flexibility," *by John Gascoyne, A.F.Inst. Pet., senior designer and stress consultant, Badger Manufacturing Co., Cambridge, Mass., U.S.A.* 181 *pages: type area* 5½*-in.* × 7½*-in. ;* 45 *line drawings ;* 9 *half-tones. Published by Sir Isaac Pitman & Sons Ltd., London. Price* 45*s. net.*

This book has been prepared with the needs of the pipe system designer in mind, although no attempt has been made to treat any aspects of the subject that are the responsibility of the specialist engineer. It should, however, serve to stimulate the interest of the student engineer, and provide him with a foundation on which to build a specialist knowledge. After dealing with the appropriate Codes and Standards, the author discusses methods of stress calculation ; preliminary data and basic assumptions ; and an elastic-centre method of stress calculation. This latter subject is included as offering perhaps the best medium for explaining the phenomena encountered in thermal expansion. There is a section devoted to the translation of results of calculations, and one covering the various types of pipe support. Also included are two sections of worked examples ; both are a presentation of a complete analysis, the first for a single-plane pipe system, and the second for a three-plane system.

International Combustion Limited

Works Extensions

THE latest extension at the Derby Works of International Combustion Limited comprises a new heavy engineering shop which has been designed and equipped for the manufacture, on the most up-to-date lines, of pressure-vessels for thermal and nuclear power stations, and for the chemical, the refinery and many similar industries. Although the primary object was to provide for the fabrication of the largest diameter heat-exchangers required in current nuclear power plant installations, the equipment in this new shop is capable of producing a wide variety of fabricated vessels such as conventional boiler drums, chemical reaction columns and similar fabricated pressure components. Furthermore, it is suitable for the machining of very large fabricated structures of all types, and for the complete assembly of plant up to the limits of weight and size permitted by either road or rail transport. A ceremony of inauguration of the extensions, in which Lord Mills, the Minister of Power, took a leading part, was held at Derby on Friday, April 24th, was attended by more than 200 guests, and presided over by Sir James Reid Young, C.A., F.C.I.S., chairman of the company.

Establishment of Derby works

The Derby works of International Combustion Limited commenced activities in 1922, when a site of approximately 55 acres was acquired on the southern outskirts of the town for a small manufacturing company known as Combustion Engineering Limited. The works then established there, initially provided manufacturing facilities for the products of The Underfeed Stoker Co. Ltd., previously operating at Newark-on-Trent. During the intervening 37 years, numerous extensions and modernisation schemes have been carried out from time to time, but the opening of the present new Heavy Engineering shop is the latest and the largest single extension made.

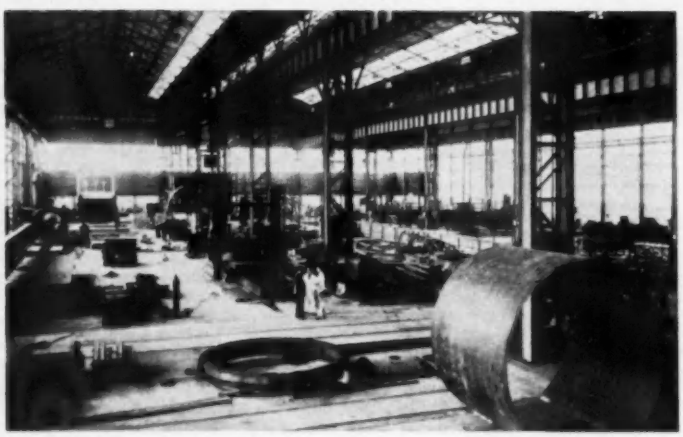
With the object of developing the use of pulverised-fuel-firing for water-tube boilers, a company was formed in December, 1923, under the names of Vickers and International Combustion Engineering Limited, which at that time was a joint venture by Vickers Limited and The International Combustion Engineering Co. Ltd. of New York. In due course, this company undertook the complete design and installation of boiler plant and much of the associated auxiliary equipment. But in 1925, Vickers Limited withdrew from the combined company, and the name was changed to International Combustion Limited. Between 1925 and 1934 there was a substantial grouping of a number of companies associated with the manufacture of boiler plant, the oldest of the companies being The Underfeed Stoker Co. Ltd., whose experience in the manufacture of mechanical stokers dated back to the 1890s. In 1934, it proved possible to re-form International Combustion Limited and these associated companies, under the single title of International Combustion Limited; and this group, operating entirely on British capital, became a public company.

During the following years, numerous subsidiary companies were included in the group in this country, and associated companies established in Africa, Australia, India and Pakistan, and Hong Kong. In 1949 the existing International Combustion Limited company changed its name to International Combustion (Holdings) Limited. At the same time, a new operating company known as International Combustion Limited was formed. The holdings company now has as its principal unit International Combustion Limited, with the manufacturing and marketing operations of the organisation vested in the several operating companies which deal, either with specific groups of products, or with export territories. At the present time the total number of employees of the group is about 4,400.

The new shop and its equipment

By courtesy of the company, we were recently invited to visit Derby works, in order to inspect the new shop, its lay-out and its equipment. The shop covers an area of 68,250 sq. ft. Preliminary work on the foundations was commenced in January, 1958, and the building was completed during September last. The structure is built up on reinforced-concrete piles, and the height from the floor to the rails carrying the overhead travelling cranes is 40-ft. There are three bays, the centre bay being 75-ft., and each wing bay 65-ft. in width. The overall length of the shop is 350-ft.

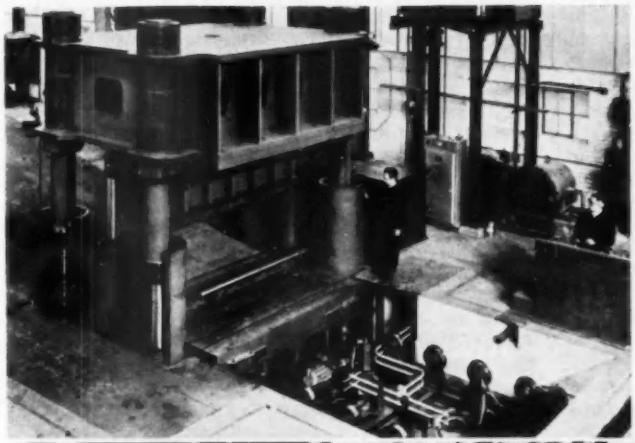
To provide additional headroom for the construction of very large diameter vessels, the centre bay contains a welding



Interior of new Heavy Engineering shop at the Derby works of International Combustion Limited.

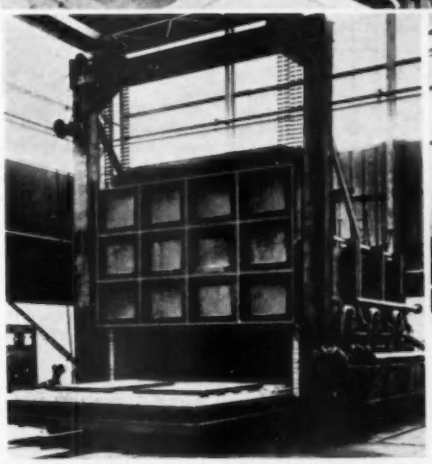
pit 150-ft. long by 25-ft. wide by 12-ft. deep. The floor of the pit carries manipulating equipment for rotating vessel sections during seam-welding, and also provides an adequately-screened space for X-ray examinations. An interesting and important constructional feature of the building is the thermal insulation provided by the provision of double panelling of the window glazing, of the general panelling, and the roof covering.

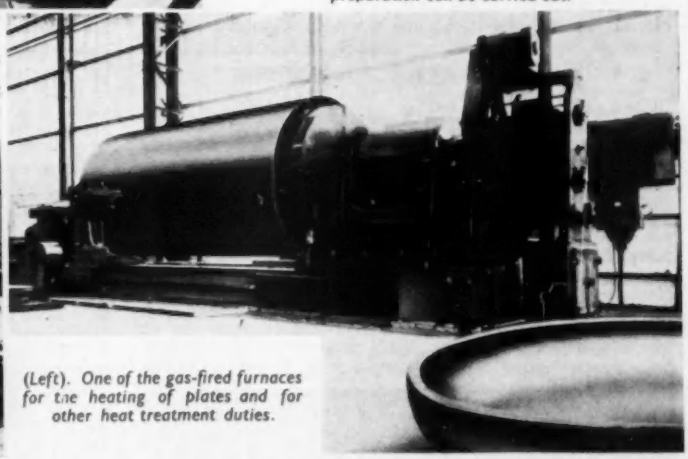
The layout of machinery around the shop perimeter is suited to the progressive stages of manufacture, each bay being served by two cranes, the heaviest of which has a lifting capacity of 50-tons. Raw material taken from the stock-yard is transferred into the main shop through the flame planer building, where the plates can be cut to size or shape, and initial weld preparations formed on the plate edges. Further edge preparation for welding is carried out on either a large planer accommodating plates up to 35-ft. in length, or on a standard planer which has a table 25-ft. long. Circumferential weld preparation can be done on a large centre lathe, or on a vertical boring machine. In the press section there are two vertical presses, each of 3,000-tons capacity, which can together handle a range of plate-bending in various widths from 3-in. thick (cold) at a minimum diameter of 3-ft., up to 4-in. thick (cold) at 25-ft. diameter. A four-column hydraulic press of 2,000-tons capacity provides for the hot-pressing of dished ends and segments for all diameters of vessels and drums. Lighter sections of plate up to 1½-in. thickness can be manipulated in the power rolls. The principal welding machine is an automatic welder equipped with a rising-boom catering for vessels up to 12-ft. 6-in. in diameter, and 50-ft. in length. These vessels can be manipulated under the welding head by means of a roller-bed installation. A number of other welding facilities of the self-propelled automatic-type are used, together with such standard d.c. and a.c. sets as are required for the work in progress. A group of three furnaces, located centrally at the south end of the shop, handle the heating of plates for "dishing," and the heat-treatment of either long or medium diameter vessels, or of large diameter sections of vessels. These furnaces are all gas-fired, have fully-automatic control for temperature regulation, and the process is recorded throughout. The largest machine installed is a vertical borer which can be adjusted to take work up to 25-ft. diameter, and is used for cylindrical edge preparation, general boring and facing. There is also a multi-purpose floor boring machine with a 3-in. diameter spindle. Tube-hole drilling, and profiling tube stubs for welding, is catered for by a duplex horizontal boring machine. Further drilling machines for angular boring, facing and plate drilling are also installed.



(Left). 2,000-ton hydraulic flanging press in new Heavy Engineering shop.

(Below). Drum lathe on which circumferential weld preparation can be carried out.





(Left). One of the gas-fired furnaces for the heating of plates and for other heat treatment duties.

The 'clean conditions' building which is entirely separate, but complementary to the heavy engineering shop, has been erected on its east side. Here, the final assembly of heat-exchangers and other similar vessels for nuclear work is undertaken in booths which are completely isolated and fully air-conditioned. The finished work can be assembled in conditions of absolute cleanliness, prior to being sealed in readiness for despatch.

Mention might also be made here of other sections of the main works. The administrative offices built in 1923, enlarged and extended in 1937, and again extended to another block in 1953, accommodate the present drawing office, and various departments and sections

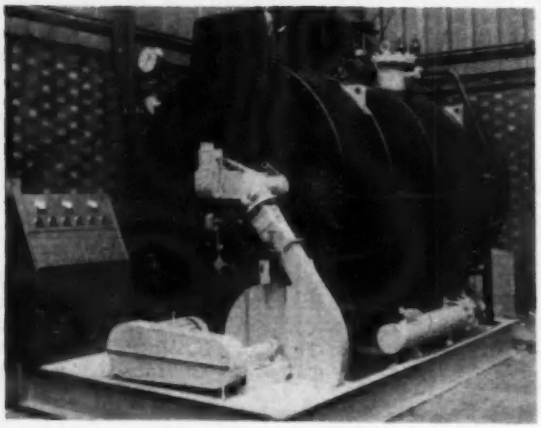
of the technical staff. Extensive facilities exist for research work. The first section of the main laboratory building was completed in 1940 and now dominates a group of associated laboratory buildings. Its facilities for development, research, and production control, have been continuously expanded to meet the highest current standards required, both for conventional boiler and nuclear power plant work. It also controls a large test house, where problems in the grinding, screening, and processing of widely diversified minerals and materials can be studied on a range of some 30 full-size plant units. The general-purpose ferrous-metal foundry provides a substantial part of the company's requirements for its own products, and has an exceptionally large pattern store, having regard to the very varied type and size of the company's products. During the past six years, the foundry has been modernised by the addition of hot-blast cupola equipment, a unique mechanical cupola charging plant, a water-jet casting cleaning unit, and the first large mains frequency metal-holding furnace to have been installed in this country. The machine and erecting shops have been laid out in such a way that the flow of material for the main varied products passes through the main shop into the erecting bays where a wide variety of pulverising mills, stokers and other industrial machines are assembled. For work of a light and more repetitive nature, a separate shop was built in 1957, for the assembly of all components which can be handled without crane facilities. The plate and structure fabricating department deals with the manufacture of platework, fabricated structures, and medium-sized pressure-vessels. Pipe and tube manipulation is also carried out in this department, which was extended in 1957 to provide a large modern template floor, and two experimental laboratories for the steam-generating test and research division.

The new and well-equipped heavy engineering shop will undoubtedly prove to be a valuable asset to International Combustion Limited, who throughout its existence has taken a leading part in the design, development, and manufacture of steam-generating plant and its associated equipment for electrical power generation, and also for industrial steam requirements both in this country and abroad. The orders which continue to be entrusted to the company are evidence of the high reputation which it enjoys throughout the world. In order to maintain this high reputation and also to provide for the future, the company has thus decided to extend on the most modern lines, its manufacturing facilities, having in mind both future development in conventional power plant, and its obligation to Atomic Power Constructions Limited, the Nuclear Group Company, of which International Combustion (Holdings) Limited are the principal shareholders.

Significant among the many orders which the company have in hand at the moment for thermal sations are the five 200-MW reheat boilers for High Marnham, and the 550-MW reheat boiler, for Thorpe Marsh, ordered by the Central Electricity Generating Board; five 120-MW reheat units for the Central Thermo-Electric for Buenos Aires [responsibility for the construction of the complete station being in the hands of a partnership formed between the B.T.H. Export Company and International Combustion (Export) Limited] and two 200-MW units for the Electricity Commission of New South Wales for Vales Point Power Station, Australia.

A NEW PACKAGED BOILER

Danks of Netherton Limited announce that they are now to manufacture a new packaged boiler, the " Supapak "—a fully-modulating oil or gas-fired unit, of all-British design and incorporating completely water-cooled high-temperature gas-passes, and the " Contraflo " heat-transfer system used so successfully in their patent super-Economic type boilers. The " Supapak " is a horizontal, wet-back boiler (patent No. 736,020), of all-welded construction; a feature of the design being the facilities provided for inspection and maintenance. A water-cooled gas-transfer port screens the circular tube-plate in the high-temperature zone from flame impact in the furnace flue, and eliminates the use of any form of refractory division between high and low-temperature gas-passages, so that " bye-passing " cannot possibly occur. The " Contraflo " heat-transfer system ensures vigorous water circulation in the lower parts of the boiler, and low exit gas temperature, resulting in the highest practicable thermal efficiency. Separate doors faced with special lightweight insulating refractory provide ready access to the furnace flue and to the water-cooled cell. The fully-automatic self-proportioning burner provided operates on the air atomisation principle, the fuel/air proportions being set to provide optimum combustion conditions throughout the entire " turn-down " output range, with a stable, high-intensity flame. The pressure controls are set to the desired boiler working pressure and varying steam demands produce an instantaneous and continuous response in the rate of firing. The safety controls cover all conditions of low-water, fuel and flame-failure and are designed under all circumstances to " lockout to safety " with visual and audible alarms, and over-riding controls in accordance with the requirements of the leading insurance companies. The lighting-up and shutting-down programming is sequence controlled, and provides " purging " periods for clearing away of any inflammable gases which might have accumulated in flues, ducting, etc. The sequence ensures that upon relighting, the burner is always set at " minimum flame." The " Supapak " is manufactured in a range of capacities from 1,500-17,500 lb./hr. and for all usual working pressures.



(Left). Front view of the new " Supapak " packaged boiler, introduced by Danks of Netherton Ltd.

(Right). An interior view of the new " Supapak " boiler

Thermal Power Station in Yugoslavia

The Sostanj power station is one of the most important in Yugoslavia, and the boilers installed have been designed to burn locally-mined lignite. Since the station was commissioned three years ago, it has operated satisfactorily, and at plant efficiencies above the guarantee figures. Certain operating results are included in these notes.

THE rich deposits of lignite at Velenje in the Solvenia area of Yugoslavia, and the rapid industrial growth in that part of the country were the main reasons for the decision to build a new steam power station at the village of Sostanj. Contracts were awarded to a group of Swiss firms for the planning, supply, erection and commissioning of the boiler plant and turbo-alternator sets. Work commenced towards the end of 1953, the first boiler/turbine unit being commmissioned in May, 1956, and the second in September of the same year. The station has an output of 60-MW, and the plant installed comprises two 30-MW turbo-alternators, which are supplied with steam from two Sulzer Bros. Ltd. Monotube boilers, each with an m.c.r. of 275,000 lb./hr., at 1,420 lb./sq. in. and 960 deg. F. The turbines, condensers, evaporators and feedwater heaters were supplied by Escher Wyss, and the generators, transformers, and large electric motors by the Oerlikon Engineering Works.

Fuel supplies

The lignite used to fire the boilers is mined at Velenje which is about a mile from the site, and conveyed by an overhead cableway to the station storage area, which has a capacity equivalent to one months' supply. Belt conveyors are used to transport the coal from the storage area to the boiler bunkers. The fuel has the following average characteristics:

Net C.V. (B.Th.U./lb.)	3,800
Moisture (per cent.)	50
Ash (per cent.)	12
Volatile constituents (per cent.) ..	26-30
Ash softening point (deg. F.) ..	1,976
Size (in.)	0-1½

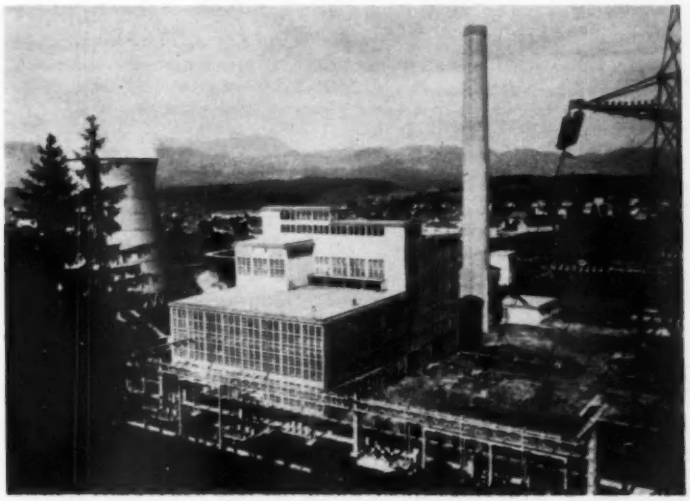
After careful consideration as to the equipment required to burn this fuel in pulverised form it was decided to utilise corner burners with direct injection by beater mills, incorporating pre-drying of the fuel by the combustion gases in a drop chute; a system developed by Kohlenscheidungs-GmbH, of Stuttgart. The decision as to whether a burn-out grate should be fitted was postponed until experience of the boilers in actual operation had been obtained. Such grates were eventually fitted, and the reasons for carrying out this modification are referred to later in these notes.

The boilers are fitted with supplementary oil-burners combined with the p.f. corner-burners, and designed to operate with either light or heavy oil. These are used primarily for ignition purposes, but they also permit the boilers to be operated at approximately 25 per cent. capacity, corresponding to a steam output of 66,000 lb./hr., when no p.f. is being burned. In this connection a complete tank installation with discharging and pumping equipment has been constructed adjacent to the station rail-sidings. From here the oil is pumped to the service tanks, and then to the oil stations within the boiler house.

Boiler plant

As previously mentioned the boilers are of the well-known Sulzer Monotube type, but in this case there was no evidence to show how the lignite fuel would behave in a modern boiler with p.f. firing. In addition the clients specified that the boilers should be capable of operating for long periods without requiring cleaning on the gas side. Detailed preliminary study was therefore essential, and the final design provided for a combustion chamber of large dimensions, with walls effectively shielded by the tube system. High heat absorption was thus ensured by the large radiant heating surface, while the risk of caking on the combustion chamber walls was reduced to a minimum. Platens connected to the superheater section were provided to keep the temperature of the combustion gases safely under the ash softening point at entry to the convection superheater, under all possible operating conditions.

The air pre-heaters provided are tubular units, this type being chosen for manufacturing reasons, and constructed in Yugoslavia to Sulzer drawings. The advantage claimed for this type of preheater is that it can be easily cleaned without dismantling. The unit is also divided



An exterior view of the new Sostanj power station, showing part of the village of Sostanj in the background.

up so that the cold end can be readily replaced if corrosion should ever make this necessary. A steam-heated air-preheater fitted ahead of the tubular unit enables the latter to be supplied with warm air at about 176 deg. F. during starting-up, or at times of abnormal operating conditions, so that the danger of the gas temperature falling below the dew point is safely precluded.

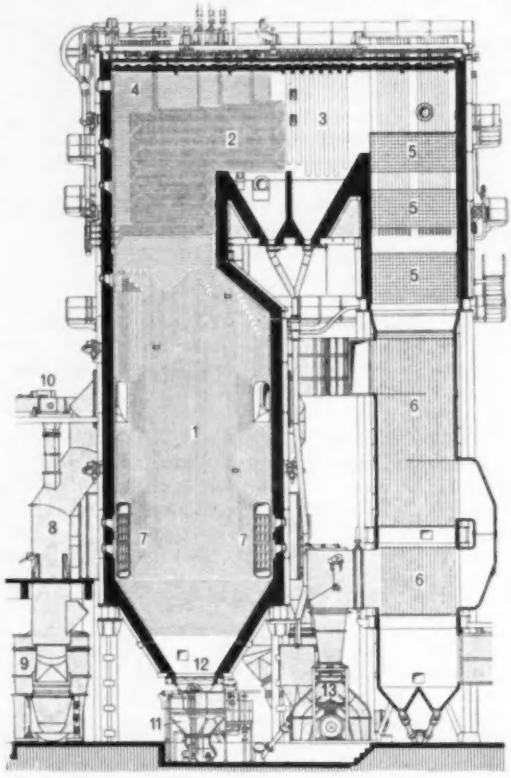
Soot-blowers have been fitted only for cleaning the combustion chamber lining and the superheater nest in the horizontal boiler pass. Provisions have been made, however, for installing soot-blowers in the economiser section if this should appear desirable in the light of long term experience.

The boilers and turbines are arranged on the unit or monobloc system, and thus form two separate sets. However, cross connections have been provided between the units on both the water and steam sides, so that in case of emergency a boiler can feed the turbine not normally allocated to it. The diagram below otherwise shows the normal flow diagram for Sulzer Monotube steam generator plants. This arrangement, in conjunction with the automatic boiler control system, permits easy starting and shutting-down and enables any operational irregularities to be safely dealt with.

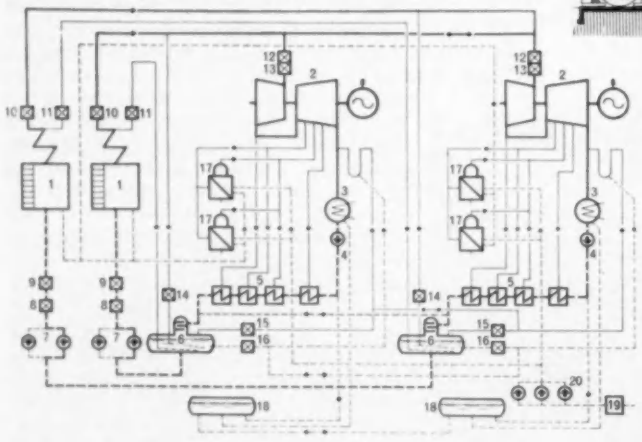
The automatic control of the feedwater flow, the final steam temperature and the pressure at the superheater outlet forms an integral part of the Monotube steam generator. In addition, the Sostanj boilers are equipped with a combustion control system also designed by Sulzer Bros. Ltd. The supply of coal is adjusted manually from the control room, according to the desired plant load, by varying the speed of the mill feed motors. The air supply and boiler draught are then adjusted automatically to suit the coal setting. The plant works in parallel with hydro-electric stations, and the use of a signal for the automatic adjustment of the coal feed was, therefore, deliberately avoided in this case in order to prevent the plant from having to follow the frequency variations of the system, which are fairly pronounced as a result of the high degree of irregularity of hydro-electric stations.

Each boiler is equipped with two forced-draught and induced-draught fans of the axial type with inlet-vane control, supplied by Kühnle, Kopp & Kausch of Frankenthal. The i.d. fans are driven by pole-changing motors, so that they can be run at either of two speeds according to load.

The layout of the piping was prepared by Sulzer Bros., who also manufactured the high-pressure pipes and fittings. The low-pressure piping and all supporting material was fabricated in Yugoslavia to Sulzer drawings.



(Above). Section through one of the steam generators. Key: 1 Combustion chamber (evaporator). 2 Platens (second) superheater. 3 Convection (first) superheater. 4 Radiation (third) superheater. 5 Economisers. 6 Tubular air-preheaters. 7 Corner-burners for pulverised coal and oil. 8 Pre-drying drop chute. 9 Coal pulverising mill. 10 Fuel supply. 11 Granulating tank. 12 Burn-out grate. 13 Forced draught-fan.



(Left). Flow diagram of the Sostanj power station. Key: 1 Monotube steam generators. 2 Turbo-alternators. 3 Condensers. 4 Condensate pumps. 5 Feed-water heaters. 6 Starting reservoirs with de-aerators. 7 Boiler feedpumps. 8 Pressure-difference regulating valves. 9 Boiler feed valves. 10 High-pressure steam admission valves. 11 High-pressure bypass valves. 12 Turbine valves. 13 Nozzle-group valves. 14 Pressure maintenance valves. 15 Overflow valves. 16 Condensate injection valves. 17 Evaporators. 18 Condensate tanks. 19 Soft-water reservoir. 20 Evaporator feed pumps.

Water treatment

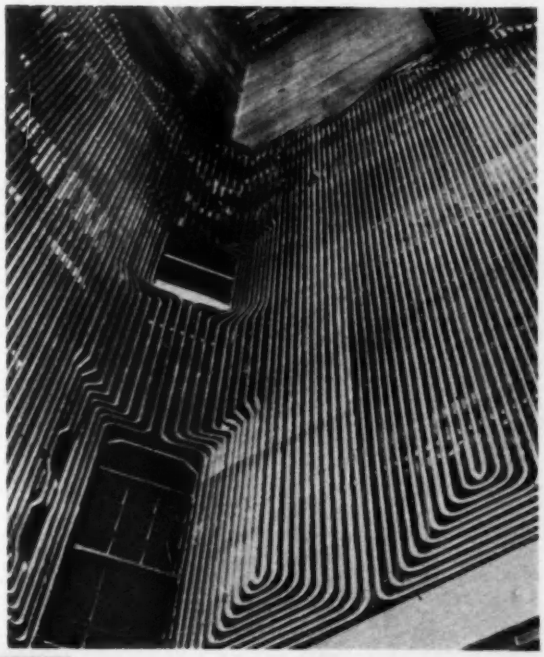
An important task with which Sulzer Bros. Ltd. were entrusted was the submission of proposals for the treatment of water for the whole plant, i.e., for the cooling towers as well as the boiler feed make-up. The problem was complicated by the fact that the discharge of the River Paka, from which the raw water was taken, is

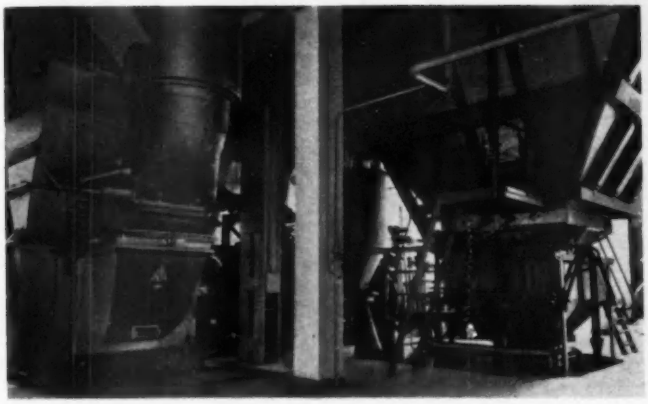
subject to very marked and rapid fluctuations. Owing to the mountainous character of the catchment area, the amount of suspended matter and of colloidal aluminium silicate in the river water may rise considerably in a matter of hours after sudden storms. The various treatment systems were examined, and it was decided to give preference, for the cooling water, to a decarbonisation plant supplied by the Roshard company of Küsnacht, Canton of Zurich, to which, however, a number of modifications were made. This plant incorporates saturators and accelerated reactors with sludge circulation. With its amply dimensioned reactors and relatively long treatment times, the plant yields a well-filtered, decarbonised water of good quality at all times in spite of the difficult raw-water conditions. A flocculating agent has to be added in the reactors at certain times, but no preliminary settling and clarifying tanks are needed. The make-up water for the boilers passes after this decarbonisation to base-exchange units in which it is distilled. A distillation plant is more suitable than a demineralisation plant for surface waters carrying large amounts of organic and suspended matter and permits good-quality make-up water to be prepared even if serious breakdown should occur in the preliminary cleaning equipment.

With sufficient supervision, any abnormalities on the water side of the tower circuit or boiler feed system are detected at once, and steps can thus be taken to deal with them before difficulties arise. For this purpose a complete set of laboratory equipment has been supplied as well as a carefully selected automatic water control system comprising recording instruments for conductivity, pH value and oxygen content.

Dust removal

Another problem that required special attention was the removal of dust from the flue gases. Only a few miles from the power station, and in the direction of the





(Above, left). Side view of the No. 2 Sulzer Monotube boiler. Both units are designed for a capacity of 275,000 lb./hr. at 1,420 lb./sq. in. and 960 deg. F.

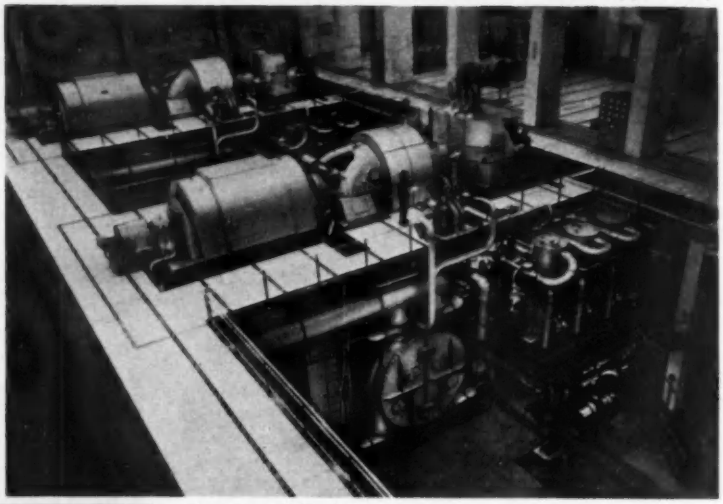
(Above). Interior of the combustion chamber, of one of the boilers.

(Left). View below one of the boilers showing the combustion-chamber hopper with granulating tank (right) and coal pulverising mill (left).

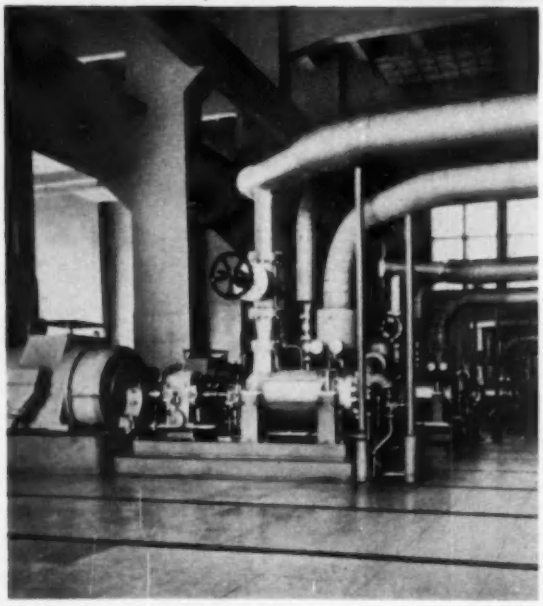
prevalent winds, there are health resorts, and there was thus no alternative to electrostatic precipitators, and this equipment was obtained from Elex AG, Zurich. As a further precaution, the dust extraction plants and chimney were designed to allow further dust-collecting devices to be installed later if this should be found necessary.

Ash and flue-gas dust are conveyed to a disposal area about 2½-miles from the station. The hydraulic system of the Seiffert company, Berlin, incorporating flushing units operated by water under pressure, was chosen for ash and dust removal from the combustion chambers and the various dust collecting points. The combustion chamber hopper is equipped with a granulating tank from which the ash passes through a slag-breaker to the hydraulic conveyor. All the conveyors of each boiler lead into a common conduit which carries the mixture of ash, dust and water to the ash sump. This is located, together with the pumps and outgoing pipes leading to the disposal area, in a building attached to the decarbonising plant.

(Right). The turbine house, showing the two 30-MW turbo-alternators supplied by Escher Wyss. In the background can be seen part of the feedpump room.



(Below). The boiler feedpumps, of the high-pressure type, were also supplied by Sulzer Bros. Ltd. Both the main, and standby units are electrically-driven.



The boilers are controlled from a control room situated in a central position between the two monobloc units, where all supervision instruments are installed. The automatic boiler and combustion control systems, which do not require regular supervision, are placed in front of the boilers. The instruments were supplied by Siemens of Zurich.

The Sulzer high-pressure boiler feed pumps are arranged between the starting tanks and the boilers and thus receive the feedwater from the last preheating stage at a temperature of approximately 383 deg. F. In order to keep the plant as simple as possible, it was decided to provide electric drive for the service and standby feed pumps. The main pump of each block is normally fed through the corresponding block transformer. If the mains supply is ever interrupted, the standby pump takes over, its motor being fed from the outgoing bus-bars by way of the transformer serving the auxiliaries. The service pump is fitted with a Voith coupling for speed control purposes, while in the standby pump the required feed pressure is obtained by throttling.

Operating results

The preparations for the commissioning of the plant may be divided into two main phases. The first of these comprised the final adjustment of the control equipment, an undertaking that was simplified as the control units had been tested in the Sulzer works at Winterthur, where a first adjustment had been made. The second phase consisted of the careful cleaning of the whole boiler system by repeated vigorous flushing-out. The design of the water separator with a detachable bottom greatly facilitates work of this nature, as all the dirt from the upstream tube system collects at this point and can be removed by opening the bottom of the separator.

Upon completion of the preparatory work, Boiler No. 1 was put into service for the first time on May 10th, 1956, and was brought up to superheat temperature. Industrial operation was commenced on May 25th, only two weeks later. Boiler No. 2, followed on September 24th, 1956,

and in view of the good results obtained with the first unit, it was possible to put it into industrial service at once at the maximum continuous load. It ran for a whole month before being shut down for the first time.

No modifications of the tube system were necessary for the purpose of improving stability. The Monotube boiler is, of course, fitted with distribution valves and a device for measuring the temperatures in individual tubes which enable all necessary adjustments and adaptations to be made at the time of starting-up. This also explains the short intervals between the first run and the commencement of industrial service.

The lignite fuel has the general characteristics indicated earlier in this article, the only difference being in the calorific value, which is somewhat higher, and has so far fluctuated on the monthly average between about 4,020 and 4,580 B.Th.U./lb. The fuel contains small particles of wood in considerable quantities, and these are difficult to pulverise on account of their fibrous texture. Initial working experience showed that the coarse wooden particles were retained in the classifiers, so that they finally collected in the mill sump and gradually choked the mill. Suitable modifications were made to the classifiers, with the result that the coal was now pulverised finely enough, but not the particles of wood. The next step was to fit the burn-out grate already mentioned on the outlet frame of the combustion-chamber hopper. The particles of wood only partially burnt in the furnace now fall upon this grate, where complete combustion can take place. These measures have proved effective, as is shown by the fact that there is now less ash from the combustion-chamber hopper, while the percentage of unburnt matter has also diminished. As a result of this reduction in the losses due to incomplete burning, combustion efficiency has been improved.

At the time of the acceptance tests, the following net efficiencies were measured:

	Boiler 1		*Boiler 2*	
Output, tons per hr. . .	103.9	125.9	103.0	126.7
Boiler efficiency — . .	89.24	88.53	88.5	88.85

These figures are well above the guarantee levels.

The dimensioning of the combustion chamber, shielding of the walls, arrangement of the heating surfaces and all other measures directed towards keeping the boilers clean have given complete satisfaction. Boiler No. 1 was shut down for the first annual overhaul after 8,230 hours of operation, having run almost all the time at the maximum continuous load. No caking whatever had taken place in the combustion chamber, and the boiler was still so clean that normal full-scale cleaning of the heating surfaces, including the air preheater, was not necessary. The same conditions were encountered in Boiler No. 2, although here the overhaul was carried out after 5,730 hours only. The soot blowers had been used only every second day.

The method of operation of the boiler control system and its behaviour under changing loads are well known and no description of them need be given here. It is, however, interesting to note that experience with the boilers to date has proved that it was justified to renounce fully-automatic frequency control and to regulate the plant load and coal supply by hand in accordance with the instructions of the grid load dispatcher.

The blades of the induced-draught fans were checked for any abrasion at regular intervals during the first period of operation. Inspection in the course of the annual overhaul showed that the fans operate at the calculated service points, that the flow enters the blades at the right angle and that there had accordingly been no detectable blade wear.

With regard to water-treatment, it should be noted that in any plant of this size the operating personnel needs a certain time to become familiar with routine water control. Variations in the quality of the treated water are therefore inevitable in the early stages, but in the present case they were never such as to jeopardise reliable operation either of the boilers or of any other part of the plant. After this initial period, the results fulfilled expectations in every way. The choice of system has proved correct, particularly in respect of decarbonisation, and in spite of the unfavourable raw-water conditions, mentioned at the outset, absolutely satisfactory water has been supplied at all times. Both the service measurements, which have now been made for over a

TABLE I

Month	Boiler 1							Boiler 2							Plant total
	Boiler working hours	Breakdowns: due to boiler	Breakdowns: due to other parts of plant	Shut-downs: No power needed [1]	Shut-downs: Overhauls	Availability	Utilisation factor	Boiler working hours	Breakdowns: due to boiler	Breakdowns: due to other parts of plant	Shut-downs: No power needed [1]	Shut-downs: Overhauls	Availability	Utilisation factor	Net heat consumption [2]
	hr.	hr.	hr.	hr.	hr.	%	%	hr.	hr.	hr.	hr.	hr.	%	%	cal.(B.Th.U.)/kWh
1956															
June	336	227	156	1	—	68.5	31.6								4574 (18,149)
July	423	—	111	210	—	100	38.4								4279 (16,970)
August ...	654	90	—	—	—	88	69.2								4155 (16,488)
September ...	671	—	49	—	—	100	80.8								3963 (15,726)
October ...	577	140	27	—	—	81.2	66.5	698.4	44	1.6	—	—	94	82	3399 (13,487)
November ...	688	—	32	—	—	100	88.3	625	79	16	—	—	89	80.8	3194 (12,674)
December ...	744	—	—	—	—	100	98.8	667.6	76	0.4	—	—	89.8	87.5	2663 [3] (8,199) [3]
1957															
January ...	744	—	—	—	—	100	94	744	—	—	—	—	100	94.2	3194 (12,674)
February ...	657	—	15	—	—	100	90.8	656	—	16	—	—	100	91.8	3071 (12,185)
March ...	728	—	16	—	—	100	96.8	718	—	26	—	—	100	95.3	3105 (12,321)
April	578	—	27	115	—	100	67.2	562	—	—	158	—	100	64.3	3282 (13,023)
May	611	—	—	131	2	100	57.6	561.7	—	7.3	30	145	100	55.3	3554 (14,102)
June	115	—	—	35	570	100	9.2	—	—	—	—	720	100	0	4195 (16,647)
July	713.8	—	0.2	30	—	100	47.7	3	—	—	593	148	100	0	3839 (15,234)
August ...	583.9	—	0.1	160	—	100	46.8	508	—	—	236	—	100	38	3691 (14,646)
September ...	683.9	—	5.1	31	—	100	80.5	639.4	—	0.6	80	—	100	76.5	3209 (12,734)
October ...	740.6	—	3.4	—	—	100	97.5	744	—	—	—	—	100	99.5	3116 (12,364)

[1] Surplus water power available. [2] Theoretical figure only. [3] See last paragraph of article.

year, and the official acceptance tests have shown that the guarantee values have been fully attained.

The water conditions in the high-pressure circuit have also satisfied requirements at all times with the exception of a few occasions during the starting period when salt entered the water through condenser leakages. Even this salt, however, was rapidly eliminated by the water separator and did not cause any unforeseen shut-downs. The values measured in the high-pressure feed water are well within the admissible limits.

The smoke from the chimney reveals at a glance that dust separation in the electrostatic precipitators is very efficient, and this is confirmed by measurements, which revealed a separating efficiency of 99.2 per cent.

The service results up to the end of October, 1957, are listed in Table I. For the purpose of assessing the results obtained, the following parts were considered as belonging to the boiler:

pulverising mills, firing system, fuel-oil plant, fans, feed pumps, control system, boiler safety valves and soot blowers.

The following were regarded as not forming part of the boiler:

water treatment plant, soft-water pumps, condensate and soft-water tanks, starting reservoir, feed-water heaters, coal transport plant, electrostatic precipitators, ash removal plant, driving motors and electrical equipment.

For the purpose of the availability reckoning, the boilers were regarded as being fit for service during overhauls and shut-downs occasioned by the failure of other parts of the plant as well as at times when there was a surplus of hydro-electric power. The less favourable availability figures in the first months of operation are normal and are due to the initial adjustments required by the various accessories. The shut-downs of Boiler No. 1 in June, August and October, 1956, were chiefly occasioned by adjustments to the firing system. As the table shows, Boiler No. 1 was never shut down because of any trouble in the boiler itself throughout the twelve-month period under review. The same applies to Boiler No. 2 over a period of ten months.

The utilisation factor given for each month is the ratio of the kilowatt-hours actually generated to the maximum possible production if the turbo-alternator had been run at maximum continuous load throughout the month. This ratio is of course reduced when shut-downs occur, while a high utilisation factor means that the plant operated for long periods at high load.

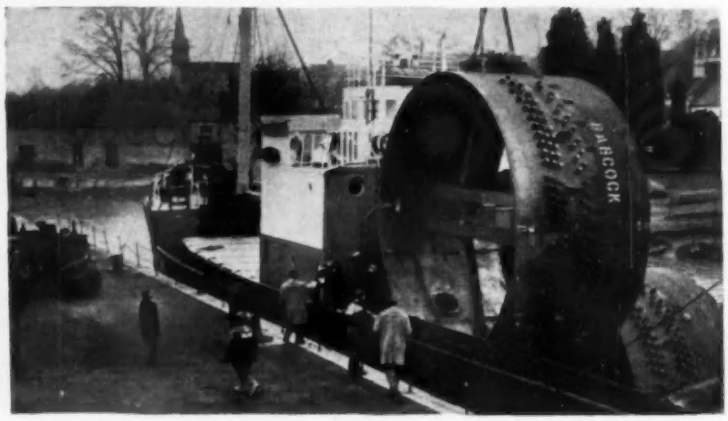
The heat consumption figures per kilowatt-hour include the auxiliary machines for boilers, turbines and other parts of the plant. They are therefore based on the kilowatt-hours given up by the outgoing busbars. All coal, light and heavy oil burnt in the month in question is allowed for in the fuel consumption figure, which therefore includes all starting and stopping operations. The measurements of fuel consumption in the various months of 1956 required correction, but the total consumption up to the end of the year was known exactly. The correction was made in the consumption for December, which explains the apparently small heat consumption for this month. From the end of 1956 onwards the measuring equipment functioned accurately, so that the monthly averages for 1957 may be taken as correct. When the project was worked out, the net efficiency (without the general auxiliaries) was calculated, for an alternator output of 30,000 kW and an evaporator make-up of 1 tonne/hr., as 27.6 per cent., corresponding to a heat consumption of 3,116 cal. or 12,364 B.Th.U./kWh. It should be remembered, in any scrutiny of the service results, that the heat consumption must naturally be higher for months with a reduced number of working hours. In months with high utilisation factors, however, the actual figure is below the theorectical value.

The heat consumption figure attainable depends on fuel quality, steam pressure and temperature, cooling-water temperature, unit output, etc. The plant described consequently cannot possibly aspire to peak efficiencies. The plant efficiencies mentioned in technical publications are usually figures arrived at theoretically for the best operating point or attained in the course of a short trial, and very often they leave the power consumptions of auxiliary machines and evaporators out of account. In the present case the figures given are actual monthly averages. The tabulated results are primarily meant to show how far the calculated values have been attained in industrial operation. They also give some idea of the reliability of the plant.

In conclusion we would acknowledge our indebtedness to Sulzer Bros. (London) Ltd., who provided much of the technical information contained in this article, in addition to the photographs used for illustration purposes.

HEAVY PLANT FOR HINKLEY

In our previous references to the Hinkley Point nuclear power station mention has been made of the reconstruction work undertaken at the small port of Combwich on the river Parret, seven miles downstream from Bridgwater, to enable heavy plant and equipment to be off-loaded there for transport by road to the station, some four miles away. The accompanying illustration shows the first of 120 sections, each 23-ft. in dia. and weighing over 40-tons, for the fabrication on site, of the twelve 90-ft. high steam-raising units, being off-loaded on arrival from the Dalmuir Works, Scotland, of Babcock & Wilcox Limited. The rebuilding of the port of Combwich will cost over £250,000, and during the next three years it is expected to cater for shipments of over 30,000 tons of various plant and equipment.



Packaged Boilers for New Distillery

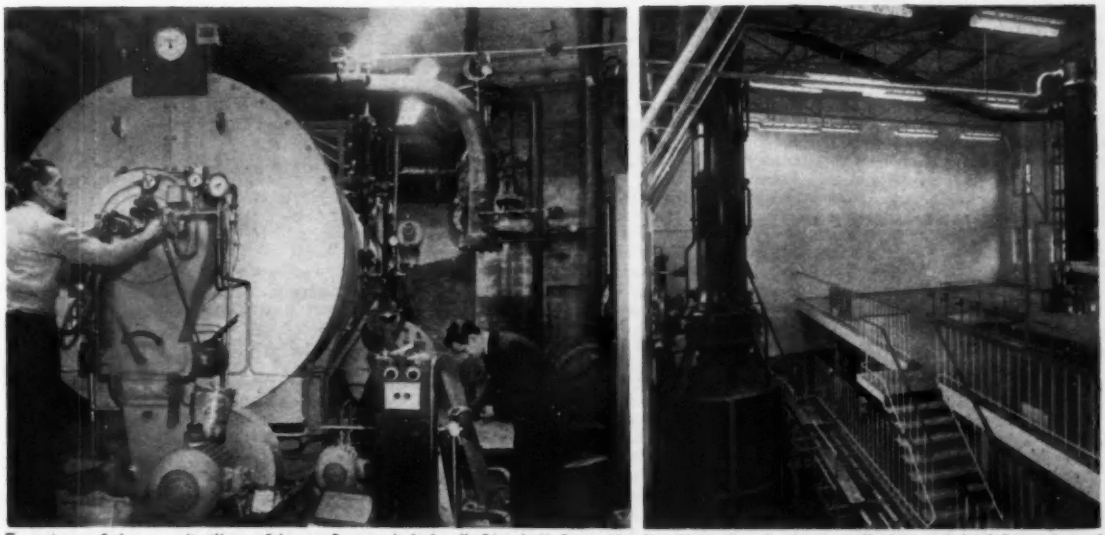
A NEW distillery and warehouse for James Burrough Limited, the manufacturers of "Beefeater" gin, will shortly be completed at Montford Place, London, S.E.11. This undertaking will have involved the conversion of an existing building, having a total floor area of 82,000 sq. ft., and ultimately it will house twelve stills, including seven rectifiers and five pot stills, with a potential output of 10,000 gallons a day. Vacant sites to the north and west are available for future expansion.

The building forms a triangle, the west wing comprising five floors with a basement, and divided by a central staircase, lift and toilet block. The south end of this wing was converted into the rectifying premises with the still room on the second and third floors, blending facilities on the first floor, receipt and despatch departments on the ground floor and a storage area in the basement. The north end required very little structural alteration for use as a bond and duty paid despatch department on the ground floor, bonded case storage area on the first and second floors, and offices on the two top floors. The north side of the triangle, comprising ground, first and second floors, was adapted for bottling and case storage, and the south wing, also on three floors, is used for general storage and bottle washing.

This plan, which was designed by Mr. Norman Burrough, production director, in collaboration with the architects, Messrs. Douglas and J. D. Wood, involved a number of problems. One of particular interest was the treatment of the walls and roof of the still house which extends upwards from the second to the fourth floors, the intervening floors having been removed to accommodate the stills. The walls are 60-ft. high and are unbraced for nearly two-thirds of their extent. The roof, which is of aluminium construction and covers an area of about 48-ft. by 70-ft. without any intermediate supports, has, therefore, been designed to act as a brace.

The steam and hot water required for the new distillery and warehouse will be provided by a Spencer-Bonecourt-Clarkson Limited oil-fired "Steambloc" No. 400 packaged boiler. This has already been installed, and the boiler house is arranged to accommodate an additional unit of the same size at some future date.

"Steambloc" packaged boilers are of the three-pass super-Economic type, available in a range with capacities from 1,500 to 18,000 lb./hr., and supplied for working pressures up to 145 lb./sq. in. or up to 245 lb./sq. in. Efficiencies of over 80 per cent. are claimed for these units, which operate under forced-draught; thus a tall chimney is unnecessary, the only requirement being a flue of sufficient height to disperse the gases. The boilers incorporate a flue that is partly corrugated and partly plain, a design feature that is said to increase flexibility and to minimise stresses due to expansion and contraction. A plain cylindrical portion at the burner end ensures correct flame development. Two further advantages are obtained from the use of return tubes of comparatively small diameter, i.e., the high velocity of the gases in a small diameter tube provides the turbulence essential for maximum heat transfer, and secondly, the mechanical properties of the boiler are improved. This latter claim is based upon the fact that such tubes not only allow wider and stronger ligaments in the tube-plate, but they are themselves more flexible and able to take up any unequal expansion due to the temperature difference between the second and third passes; without the tendency to distortion of the tube-plate and consequent leakage, which might occur with stiffer tubes.



Two views of the new distillery of James Burrough Ltd. (Left), the "Steambloc" 400 boiler during installation and (right), a view of the still-house showing the first rectifying still and its associated condenser in position.

Heavy grades of fuel-oil up to Bunker " C " may be burned ; steam and electrically-operated, thermostatically controlled oil-heating equipment being provided prior to the actual burner equipment which is of the pressure-atomising type. Butane or propane gas is used to provide a pilot-flame, which is ignited by an electric spark, and in turn ignites the main burner. The boiler feed system fitted integral with the " Steambloc " comprises a supply tank provided with a float-valve, electrically-driven feed-pump and standby steam-operated injector.

The boiler is completely automatic in operation, and a control cabinet forming part of the unit contains electronic and electro-mechanical devices which ensure safety in operation and provide purging of the gas passes before starting-up, and total, immediate shut-down in the event of flame-failure, or excessive steam pressure. Twin Mobrey controllers provide a close control of water-level with complete shutdown and alarm on low-water. The programming sequence control unit incorporated is manufactured by Fireye Controls Limited. In conjunction with the automatic control gear, the burner equipment is arranged to give modulated flame control for loads down to one-third of normal rating, while below this load the regulation is by " on-off " control.

The boiler shell is covered with lagging and steel cleading to reduce heat losses to a minimum, but full access for tube cleaning and inspection is provided by a quick-release door at the back of the boiler ; this door also carrying part of the combustion-chamber refractory lining. A small soot-door is provided in the front smoke-chamber for the removal of dust and deposits.

The actual boiler installed at the new distillery, the " Steambloc " No. 400, has a capacity of 10,000 lb./hr. Overall dimensions are length 22-ft. 3-in. and height 12-ft. 3-in. The full-load oil consumption is approximately 67 gal./hr. The oil-pump motor is rated at 1.5-h.p., the forced-draught fan motor at 12.5-h.p., and the feedpump motor at 10-h.p. The oil heaters have a total rating of 12-kW.

The boiler, as stated above, is oil-fired, the fuel being 900 sec. oil, which is stored in a steam/electrically heated tank ; the steam/18 kW electric heater being supplied by A. K. Waugh. The oil is maintained at a temperature of 120 deg. F. in the delivery pipe to the boiler by electric tracing. Flash steam is kept to a minimum by preheating the domestic hot water in a coil running through the condense hotwell, where all the condensed steam is collected before it is returned to the boiler. The steam and condensate pipes have been insulated by Newalls Insulation Co. Ltd. Cooling-water from the still-heads at approximately 180 deg. F. is taken into a storage tank and then piped, to the condense hotwell where it serves as make-up water, and to the bottle-washer.

The major use of steam is in the still-room, where at the present time plans are in hand to provide 12,000 lb./hr. at 80 lb./sq. in. for five large stills, and 3,000 lb./hr. at 40 lb./sq. in. for six small stills. The " boiling " of these stills is controlled by hand, and the operator requires an unvarying steam pressure on the main. To achieve this a large easily-read 12-in. dial pressure gauge has been fitted in the still room, and a Hopkinsons Limited electric-relay pressure-reducing valve has been fitted in the boiler house to provide a constant pressure of 80 lb./sq. in. Steam is also used in a large machine for washing and sterilising empty bottles. Heating of the building is by Ideal Standard radiators in the offices and Coppered unit heaters and fan convectors in the still room, served by a low-pressure hot pumped circulating system, using a Holden & Brooke Limited circulating-pump. The heated water is fed from a thermostatically-controlled steam-heating calorifier, taking 2,400 lb./hr. (2,225,000 B.T.U./hr.) The circulating-pump and the Satchwell thermostatic controls provided are time-switch-operated so that they can be switched on and off automatically. The domestic hot water service is provided by a steam-heated calorifier, thermostatically-controlled with a Sangamo Weston Limited time-switch in a similar manner to the heating controls. Two pressure-switches have been fitted in the boiler header. These have been set so that if the boiler header pressure falls to 90 lb./sq. in. the heating and hot water service supplies are shut off, allowing all the steam generated to pass to the still room.

Rosser & Russell Limited were responsible for the boiler house, steam and central heating installation.

It is with regret that we record the death on April 5th of **Mr. L. E. Harris,** A.M.I.Mech.E., M.I.W.E., F.R.Hist.S., president of the Newcomen Society for the Study of the History of Engineering and Technology. Lawrence Ernest Harris was born at Sydenham, London, in 1892. After leaving Mercers School, London, he studied from 1910 to 1912 in the Civil and Mechanical Engineering Department at the City and Guilds (Engineering) College, South Kensington, where he won a Mitchell scholarship. He was apprenticed to C. Isler and Company, London, artesian well engineers. He served in the Royal Fusiliers and Machine Gun Corps from 1914 to 1919, being invalided out of the Army on account of war wounds. After a post-war refresher course at King's College, London, he joined Sulzer Brothers Limited, as an estimating engineer in the London office for four years. In 1923, after spending three months at the Winterthur works of that firm, Harris became its manager in India for thirteen years, during which period he was responsible for the installation of the Sulzer plant and equipment at several power stations and pumping stations. Returning to England he was, from 1937 till his death, the district manager and engineer for the Sulzer organisation in the Fen area, specialising in fen drainage and pumping machinery. He lived at Histon, Cambridge. He also installed Sulzer pumping plant for the Somerset River Board's drainage schemes. Mr. Harris was the author of various papers to the Newcomen Society, including " Sir Cornelius Vermuyden, an Evaluation and an Appreciation," and " On the Early Development of Centrifugal Pumping Machinery, 1689-1856." His presidential address in 1958, entitled " A Neglected Genius of Seventeenth Century Technology," gave credit, long overdue, to Cornelis Drebbel (1562-1633) of North Holland. Harris conceived the idea of forming a Trust to preserve the Stretham beam engine complete with scoop-wheel. He became the first chairman of the Trust in 1958.

The **Central Electricity Generating Board** have placed contracts during the past month for power stations, transmission lines and transforming stations amounting in the aggregate to approximately £7,567,000. Some fo the principal contracts include:—Northfleet power station. Coal-handling plant—Civil works, and ancilliary works on sites (*Taylor Woodrow Construction Limited*). Richborough power station: Reinforced-concrete piling (*West's Piling & Construction Co. Ltd.*). Coal-handling plant (*George Wimpey & Co. Ltd.*). West Thurrock power station: Coal unloading cranes (*Stothert & Pitt Limited*). Ash-handling plant (*Babcock & Wilcox Limited*). Padiham " B " power station: Slag conveying plant (*Mitchell Engineering Co. Ltd.*). Rugeley power station: Instruments and controls—Nos. 3, 4 and 5 units (*Electroflo Meters Co. Ltd.*). Integral reheater inlet and outlet steam piping (*Babcock & Wilcox Limited*).

RECENT *Equipment* AND *Accessories*

Electronic process timers

A new series of electronic process timers has recently been added to the wide range of such equipment already produced by Lancashire Dynamo Electronic Products Ltd. The new units, known as Series PCT.1, are available in six basic forms depending upon the required time range, and can be connected together to provide multi-stage timing control for complete processes. The six basic models are designed to provide time ranges of 0.1 to 1.5 sec.; 0.3 to 5 sec.; 1 to 15 sec.; 3 to 50 sec.; 10 to 150 sec.; and 30 to 500 sec. Each main time range is sub-divided into "long" and "short" ranges selected by a switch, and a continuously variable control is provided for accurate setting of the required time interval. The units have a repeat accuracy of ± 1 per cent., on a stable supply, and variations in supply voltage of − 15 to + 10 per cent. will not cause more than ± 5 per cent. change in the "set time" interval. The process timers are housed in a cast light-alloy case which is designed for wall or base-mounting. Suitable sealing arrangements are provided on the detachable covers to prevent the ingress of dust and moisture. The timing controls are mounted on the front of the case, the time setting control being provided with a scale calibrated directly in seconds. The timers are designed for 200/250 volts or 110/115 volts 50/60 c/s, single-phase supplies. (*Lancashire Dynamo Electronic Products Ltd., Rugeley, Staffs.*)

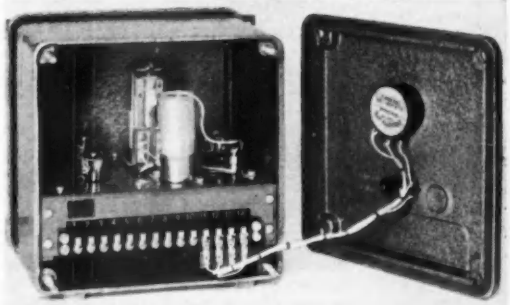


Fig. 1 (left). View of the new series PCT.1 process-timer. (Lancashire Dynamo Electronic Products Ltd.)

Pressure and vacuum gauge testing

Bryans Aeroquipment Ltd. have made available a portable item of test equipment for checking both pressure and vacuum systems at positive and negative pressures within the range of 1-lb./sq. in. abs. to 115-lb./sq. in. abs., i.e., negative pressures 0-30-in. Hg., and positive pressures 0-100 lb./sq. in. A feature of the tester is that the necessary gauges may be checked without removal from the case, against a standard such as a manometer, gauge or other means of reference. The tester is connected to a standard reference and the pump operated to the required pressure. A comparison is then made between the reference and the test gauge. A hand pump of the piston-operated type supplies positive and reduced pressures within the range quoted above. The pump is self-sealing by means of non-return valves contained in each pressure connection. The pressure line connects the positive pressure side of the pump to a gauge and two capped connections, and is provided with an atmosphere vent valve. The negative pressure line connects the negative pressure side of the pump to a gauge and two capped connections, and is provided with an atmosphere vent valve. Each gauge is fitted with a choke to prevent sudden surges of pressure to the test set instruments. The standard model is fitted with a pressure gauge covering the range 0-100 lb./sq. in., and two other ranges of gauges are available as required covering the range 0-25 and 0-50 lb./sq. in. Other types of gauges within a range of 0-100 lb./sq. in. or equivalent can also be supplied. The negative pressure gauge is ranged 0-30 in. Hg. and is standard for all test sets. (*Bryans Aeroquipment Ltd., 15, Willow Lane, Mitcham, Surrey.*)

Plug-in type relay

The Londex Ltd. type-LF relay is now available in plug-in form, to provide a unit which can be changed with the minimum of disturbance and which ensures easy maintenance, particularly on assembly-line control circuits where it is often used. An 18-way plug and socket is used which allows for a wide variety of contacts to be accommodated. Maximum is eight "normally open," or eight "normally closed" or any combination. Alternatively, five changeover contacts can be fitted. The rating of these is 4-amps at 250 v. a.c.

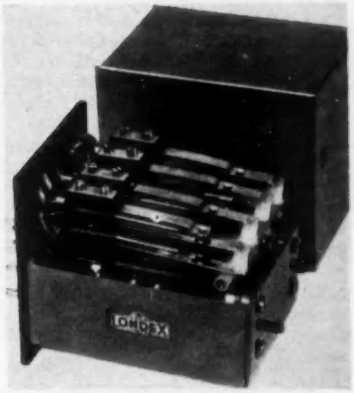


Fig. 2 (right). The Londex Ltd. type-LF plug-in relay. (Londex Ltd.)

Operating voltage for the coil can be from 2 to 600 v. a.c. or up to 180 v. d.c.; power required is from 4 to 12 VA depending on the number of contacts. A retaining clip is fitted to the socket holding the relay firmly in position. Overall dimensions of the new relay are 2¾-in. × 3½-in. × 4⅜-in. (*Londex Ltd., Anerley Works, 207, Anerley Road, London, S.E.20.*)

Overhead travelling crane

The "Reel" electric overhead travelling crane, already well-known on the Continent, is now being manufactured in this country by the sole British licensee, British Industrial Engineering Co. (Staffs) Ltd., and will be available in capacities up to 40-tons and spans over 100-ft. As a departure from the traditional boxed lattice frames, Vierendeel-type girders are used in their construction, while a similar arrangement across the upper chord provides the necessary lateral stiffness, eliminating the need of outrigger frames. Fabricated box section cross-members to the top chord are continued down the outside of the bridge girders to form portal frame stiffeners. The crab unit runs inside the bridge, underslung from the channel booms allowing the crane to be carried high in the

building within 2 or 3 in. of the roof work. The crab itself is compact, and arranged to obtain maximum lift in a given height of building. An initial camber, dependent on the span and load, is built into the bridge. End carriages are box section fabricated from steel plates stiffened internally, the wheels thus being totally-enclosed. The end carriages are welded to the bridge girders, a feature contributing to the general stiffness. Frictional losses have been kept to a minimum by the use of ball or roller bearings throughout, and to reduce noise to a minimum the rail wheels and the final reduction gears of the long travel drive are enclosed within the end carriage fabrications, while the drive from motor to long travel shaft is by amply rated high capacity vee-belts. A worm gear box is used for the cross-traverse reduction with a chain drive to the wheel axle. Similarly, worm reducers are used for the hoist motion, with, for the larger capacity cranes, a final spur ring and pinion reduction. The electrical equipment incorporated can be varied to suit customers' requirements, although, in general, the manufacturers suggest contactor gear. [*British Industrial Engineering Co. (Staffs.) Ltd., Tividale, Tipton, Staffordshire.*]

A lightweight angle sander

A new lightweight angle sander, the CP 3017 AWS, on which either 5-in. or 7-in. rubber pads, or 7-in. "Flexback" pads can be fitted for wet sanding of irregularly shaped surfaces, has been introduced by the Consolidated Pneumatic Tool Co. Ltd. The new sander is available in three versions with spindle speeds of 4,500, 2,700 and 1,500 r.p.m. respectively. The drive in each case consists of a high-powered "unit-type" vane motor which incorporates a floating rotor. Thus, the company claim, while 50 per cent. more power is obtainable than with other types of motor, end plate wear is eliminated. Ball or needle bearings are used for all revolving parts, and lubrication of the motor is effected by a built-in oil reservoir; the gearing being lubricated through a convenient filler plug without disassembly of the gearing. Water feed to the sanding pad is by means of a water connection feeding through the spindle shaft, and the tool is supplied with air for operation from a ½-in. diam. hose. A lever-type throttle is standard, and this is used in conjunction with a "dead" handle. (*Consolidated Pneumatic Tool Co. Ltd., 232, Dawes Road, London, S.W.6.*)

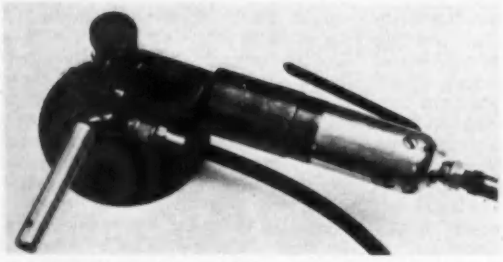


Fig. 3 (left). The new 3017 AWS light-weight angle-sander. (Consolidated Pneumatic Tool Co. Ltd.)

Transistorised electronic/pneumatic level controller

Fielden Electronics Ltd. have introduced a new "on/off" level controller, the "Pneutronic," which provides an output air-pressure suitable for operating a standard pneumatic diaphragm control valve, and can be used for controlling the level of solids or liquids which may be at high temperatures, high pressures or under corrosive conditions. The instrument functions by measuring the change of electrical capacitance of an electrode mounted in the container, and there are, therefore, no diaphragms, floats, pivots, gears, etc., in the container to become clogged or worn. The instrument is housed in a sheet metal, weatherproofed case, and requires an electrical supply of 12 volts d.c., and a supply of clean dry air at 17-20 lb./sq. in. The output pressure is either zero or line pressure, dependent upon the level of the material in the container; these being the two stable states of the controller, and in either condition no air is consumed, since there is no continuous bleed to atmosphere. Air is only consumed from the compressor when the pressure to the control valve is being increased from zero to line pressure. The transistorised electronic circuit is in the form of a completely-sealed plug-in unit. (*Fielden Electronics Ltd., Wythenshawe, Manchester.*)

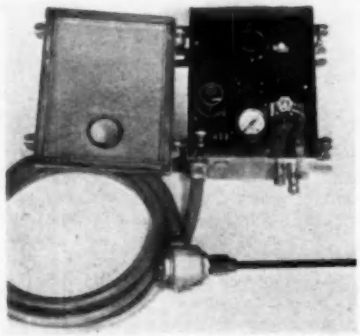


Fig. 4 (above). Interior view of the "Pneutronic" on/off level controller with associated electrode. (Fielden Electronics Ltd.)

Multivane-type fans

Two new products are announced by The Standard & Pochin Bros. Ltd., the "QP" and "QM" multivane-type centrifugal fans. The "QP" unit is available in four sizes (8 to 14-in.) to provide air volumes of from 300 to 1,800 cu. ft./min. with outlet velocities of from 900 to 1,800 ft./min. They are belt-driven from an electric motor rated at ½-h.p. (¾-h.p. for some duties), and running at 1,440 r.p.m. The "QM" unit is available in three sizes (8 to 12-in.) to provide air volumes up to 800 cu. ft./min., with outlet velocities up to 1,500 ft./min. These units are direct-driven from a variable-speed, patented non-overloading electric motor. The use of low velocities and low tip speed, combined with certain mechanical and electrical features, is claimed to make this new range of fans particularly suited to conditions requiring a low noise level. (*The Standard & Pochin Bros. Ltd., Evington Valley Road, Leicester.*)

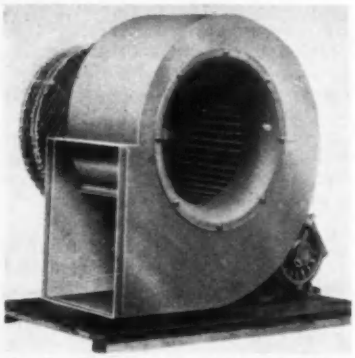


Fig. 5. The "QP" multi-vane centrifugal fan, available in four sizes to provide air volumes of from 300 to 1,800 cu. ft./min. (The Standard & Pochin Bros. Ltd.)

Solenoid valve for viscous oils

A new solenoid valve for overspill type burners designed for use with fuel-oil at viscosities ranging from 200 to 1,000 sec. Redwood No. 1 at pressures between 0-300 lb./sq. in., has been introduced by Teddington Industrial Equipment Ltd. A special feature of the new valve is the provision of a change-over switch, operated by the valve spool, which enables the operation of the valve to be interlocked with the

burner programme circuit to ensure that the correct sequence is initiated and/or maintained. It can also be used to operate a remote valve position indicator. The valve is of the balanced, slide pattern, the valve spool being controlled by a double-wound solenoid which is employed in order to provide sufficient power to overcome the initial viscosity of the oil when the plant is started up from cold. When the valve is energised, the armature—to which the spool is attached—is attracted into the solenoid core against a return spring and in this position opens one of the outlet ports and closes the other. At the same time, it operates a multi-leaf switch, the first set of contacts opening to disconnect the solenoid "pull-in" winding, and the second set changing over from one signal circuit to another. The two sets of contacts are linked mechanically but are electrically independent. When the valve is de-energised, the armature returns to its normal position reversing the valve spool and the switch contacts. Alternative outlet ports are provided so that the standard model may be used either as a simple cut-off valve or as a diverter. One of the three ports is normally plugged and, by simply changing the position of the plug, the valve can be readily converted from "normally-open" to "normally-closed" operation. A built-in adjustable by-pass is provided to enable pre-heated oil to be circulated through the valve continuously. To ensure maximum efficiency and quiet operation, the solenoid is wound for 220 V d.c. but a small chassis mounting rectifier is available as an optional extra for use with a.c. supplies. (*Teddington Industrial Equipment Ltd., Sunbury-on-Thames, Middlesex.*)

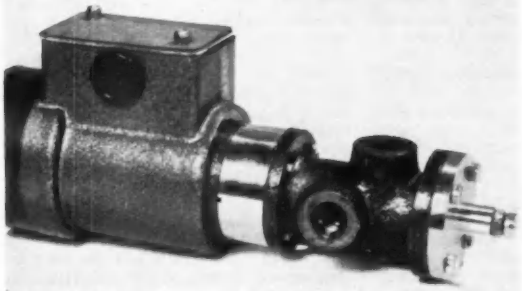


Fig. 6 (left). The new type-WU solenoid valve for viscous oil. (Teddington Industrial Equipment Ltd.)

Fig. 7 (below). The "Hydramatic" high-speed hacksawing machine. (Charles Wicksteed & Co. Ltd.)

High-speed hacksawing machine

Charles Wicksteed & Co. Ltd. have introduced the "Hydramatic" 8-in. by 8-in. capacity high-speed hacksawing machine to replace their previous 8-in. model. The improved hydraulic control unit incorporated on the new model enables fast, accurate cutting speeds to be obtained from 16-in. by 1¼-in. by 0.062 (thin) blades, which give quicker cutting at less cost per blade. Cuts may be taken at angles up to 45° on bars up to 5-in. by 8-in. Two cutting speeds of 70 and 130 strokes/min. are provided, the drive being taken from a 2-h.p. motor through vee-belts and gears. There are two controls at the front of the machine for all functions. When once the required cutting pressure has been set only the motor starter button and foot pedal need to be used for each cutting cycle. Automatic lift to the bow and motor cut-off are incorporated. The coolant supply is provided by a gear pump. (*Charles Wicksteed & Co. Ltd., Stamford Rd. Works, Kettering.*)

Electronic strip-chart recorder

George Kent Ltd. announce the addition of the Mark 3 "Multelec" high-speed electronic strip-chart indicator-recorder to their general industrial range of instrumentation and control equipment. The new unit is at present available for the measurement of millivoltage, and also temperature, in association with thermocouple, resistance thermometer or radiation pyrometers. Features of the Mark 3 include an operating speed, with no pointer "overshoot," of 2 sec. only for full-scale travel; all-mains operation with continuous standardisation; re-designed chart-drive unit, permitting variation of chart speeds from 1-in./hr. to 4-in./min.; a 10-in. chart width and pen travel; extremely sensitive, high-gain amplifier, covering a wide range of a.c. or d.c. input conditions; sealed-unit maintenance-free servo-motor with built-in tachogenerator; and a synchronous converter capable of detecting smaller signals than any other available. The last three components are available for other applications as separate units. The Mark 3 "Multelec" is available in single or multi-point form, with point-cycle times of 5, 10 or 20 sec., depending on the application, enabling up to 16 variables to be measured and recorded consecutively. (*George Kent Ltd., Luton, Beds.*)

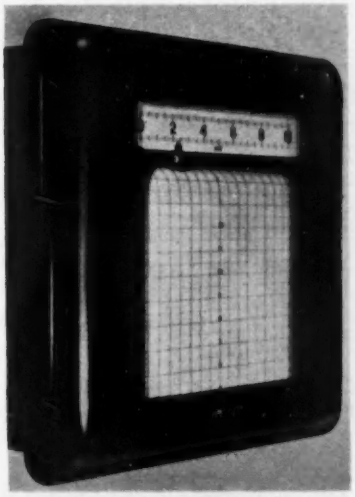


Fig. 8. The Mark 3 "Multelec" recorder arranged for multi-point measurement. (George Kent Ltd.)

Angle head drills

Two new angle-head pneumatic drills designed to speed up production drilling in corners, crevices and other similar locations have been announced by The Airetool Mfg. Co. These special tools, available as 600, 1,100, 2,200, 3,000 and 5,000 r.p.m. models, are for high production work, and both are lightweight, yet provided with powerful pneumatic motors. The Model 400-AA drill features an all-angle head, adjustable through 360°, has a ¼-in. capacity, is 8¾-in. long and weighs 2¾ lb. The Model 400-RA drill has fixed 90° angle head, has a ¼-in. capacity drill, is 10¼-in. long, weighs 3⅛ lb. Both models are equipped with lever or lock button throttle control and three-jawed chuck. (*The Airetool Mfg. Co., Springfield, Ohio, U.S.A.*)

Automatic pneumatic/electric controller

The Cambridge Instrument Co. Ltd. are to manufacture an entirely new and inexpensive automatic controller, known as the "Numalec," which will have a wide range of applications throughout industry. It will control temperature, pressure, vacuum, level, etc., each for set (adjustable) periods and in the sequence required. A complete manufacturing process may be controlled, or in its simplest form the unit will raise the temperature of, for example, an electric oven, to a set value, maintain the temperature for the required period, switch off and indicate completion of the cycle. In all cases, operation is extremely simple, the sequence being initiated by pressing one button. The controller is, however, so versatile that the whole programme can be changed within 3 min. (*The Cambridge Instrument Co. Ltd.*, 13, *Grosvenor Place, London, S.W.*1.)

PORTISHEAD "B" POWER STATION

The Portishead "B" power station of the Central Electricity Generating Board, South Western Division will, when completed, have an output capacity of 390-MW. Five of the 60-MW turbo-alternator sets are already installed, and the accompanying illustration shows the progress made to date on the sixth and final set. These machines, together with the necessary condensers, transformers and switchgear for the station, were supplied by Metropolitan-Vickers Electrical Co. Ltd., whose turbine-generator interests are now merged in the A.E.I.

turbine-generator division. The steam supply to the turbines will be provided by eight pulverised-fuel fired boilers, supplied by Mitchell Engineering Limited, each of 300,000 lb./hr. capacity, and with steam conditions of 950 lb./sq. in. and 925 deg. F., with feed-water at 385 deg. F.

The Hodgkinson Group exhibit at the recent Factory Equipment Exhibition included the Hodgkinson "Low Ram" stoker for shell-type boilers; the Bennis chain-grate stoker which is suitable for burning a wide range of fuels; and the Hodgkinson "Meter-feed" underfeed stoker for boiler, kiln and furnace applications. In addition there was an 8-in. chain and bucket elevator, the Scorer destructor for the hygienic and economic disposal of waste, and the Saxon resiliently-mounted screen.

* * *

The address of **The Combustion Engineering Association** is now:—70, Jermyn Street, London, S.W.1. (Telephone No.: Whitehall 5536.)

An outstanding feat of engineering was completed by the then Central Electricity Authority in 1932 when a double circuit 132-kV transmission line was carried across the River Thames at Dagenham on 487-ft. high towers which at that time, were the tallest transmission towers in Great Britain. The board's consulting engineers for that work were Messrs. Merz and McLellan, and the installation of the crossing, which has a span length of 3,060 ft., was carried out by the former Callender's Cable and Construction Co. Ltd. The Central Electricity Generating Board has recently awarded to British Insulated Callender's Construction Co. Ltd., a member of the BICC Group, a contract for the supply and installation of another overhead crossing of the River Thames. This will be erected about eight miles down stream from the existing crossing. The new crossing is designed for a working voltage of 380 kV, but will operate initially at 275-kV. This scheme will form part of the British supergrid system, and the crossing, which will be located at West Thurrock on the Essex bank, will enable a connection to be made to the Channel coast.

* * *

The General Electric Co. Ltd. has received a contract in the region of £4 million for two 200-MW turbo-generators and auxiliary equipment. The sets will be installed at the Kincardine generating station of the South of Scotland Electricity Board, and are the largest so far ordered for a Scottish power station. The turbines will be designed for steam conditions of 2,350 lb./sq. in., 1,050 deg. F. with reheat to 1,000 deg. F., vacuum 28.9-in. with 55 deg. F. cooling-water temperature. The feed-heating will be in seven stages to a final feed temperature of 460 deg. F. The generators will be hydrogen-cooled at a pressure of 50 lb./sq. in. and will have an output of 235,000-kVA, 0.85 p.f., three-phase, 50 c/s at 16-kV. The generator rotors will have hollow conductors direct-cooled by the hydrogen—the same arrangement as adopted for G.E.C. machines already in service with a hydrogen pressure of 30 lb./sq. in. The stator conductors will be liquid-cooled. The contract includes condensing and feed-heating plant which will be manufactured by G. & J. Weir Limited.

* * *

An order worth £20,000 for public electricity supply transformers has been received from the Electricity Department of the City Council of Singapore, by the **Gresham Transformer Group,** Twickenham Road, Feltham, Middlesex. The order consists of twelve 500-kVA and fifteen 300-kVA transformers.

Mr. Y. B. Chavan, Chief Minister, Bombay State, officially opened the new "Kanjur Works" of Crompton Parkinson (Works) Private Ltd., a few weeks ago. These works will house the transformer, switchgear, and motor control gear departments, thus enabling the industrial motors, f.h.p. motors, and fan production facilities to be expanded at the company's "Worli" works. **Mr. P. R. Deshpande,** director and general manager of the company, during a speech introducing the Chief Minister, gave details of how C.P. (Works) Private Ltd. commenced manufacture of electrical equipment in 1938 in a small factory at Worli for the production of ceiling fans, and how the addition of the various other products has caused a steady expansion to the physical limit of the Worli site. The new factory, roads and services, on a 35-acre site, were completed in record time and most of the new plant and machinery needed for expanding existing production has been commissioned. The "Kanjur" site is at Bhandup, near Bombay.

* * *

Dr. F. H. Last, Ph.D. (Eng.), B.Sc. (Eng.), A.M.I.E.E., technical engineer of the Eastern Division, C.E.G.B., has been appointed regional research and development officer of the Eastern, London and South Eastern Region. Dr. Last joined the Research Department of the Central Electricity Board in 1939. In 1940 he transferred to the technical department of the South East England District of the same organisation. At vesting date, Dr. Last was appointed senior assistant to the technical engineer of the Eastern Division, British Electricity Authority, becoming technical engineer in 1953, a post which he has held to the present date.

* * *

A new sub-office of **The English Electric Company** has been opened at 14, Albert Road, Middlesbrough (telephone, Middlesbrough 44346/7). **Mr. A. R. Johnson,** B.Sc., A.M.I.Mech.E., A.M.I.E.E., A.M.I.Prod.E., is in charge, and is responsible to the manager of the English Electric branch office at Newcastle upon Tyne, **Mr. W. D. M. Lywood,** A.M.I.E.E.

* * *

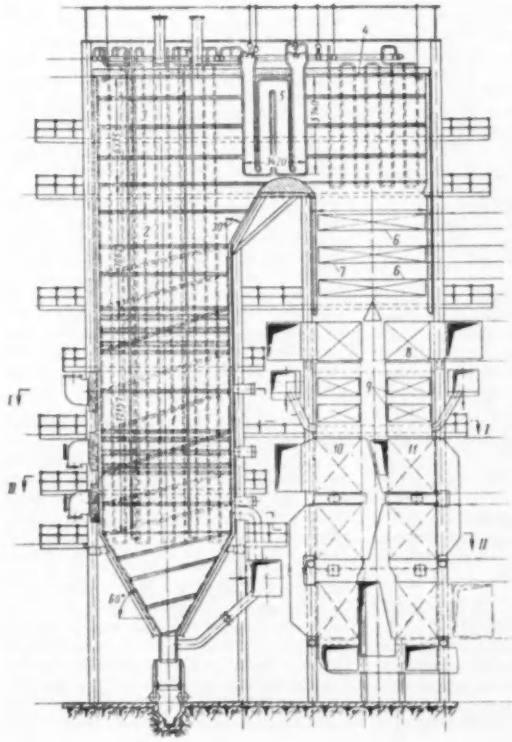
The Electric Motor Division of **Newman Industries Limited** has opened an additional area office at 59, Grey Street, Newcastle upon Tyne, 1 (telephone, Newcastle 2-3970). The new area manager is **Mr. R. Martindale.** A stores, adjacent to the new office, will carry stocks of electric motors, and the company states that these facilities will provide a more efficient service in the north east of England.

OVERSEAS Steam Engineering Practice

Abridgments of recent articles in the colonial and foreign technical press, concerning design and progress in the technique of steam generation and power plant equipment

Large Russian once-through boiler

A large once-through forced-flow boiler to supply steam to a 200-MW turbo-alternator set was installed at the Podolsk Machine Building Works during 1957. Live steam is admitted to the turbine at 130 kg/sq. cm. (1,849 lb./sq. in.) pressure and at a temperature of 565 deg. C. (1,049 deg. F.) and after partial expansion is reheated in the boiler and re-admitted at the same temperature. The boiler, which is rated at 1,408,000 lb./hr., is designed for an operating pressure of 140 kg/sq. cm. (1,991 lb./sq. in.) and a temperature of 570 deg. C. (1,058 deg. F.), the reheat steam temperature also being 570 deg. C. (1,058 deg. F.). A side elevation of the boiler is shown in the accompanying illustration. The furnace is sub-divided across its width into three compartments by means of two water-tube division walls. In the horizontal gas-pass connecting the furnace with the vertical down-pass is located the final stage of the live steam superheater. It consists of vertical panels placed at a pitch of 700 mm. (27.5 in.). From this superheater the gases pass successively into the final reheater stage, the transition zone, the first stage of the reheater, the second stage of the twin-flow tubular primary air-preheater, the economiser, and the first stage of the primary air-preheater and the secondary air-preheater located side by side. When firing Chelyabinsk coal, the fuel consumption is 144 ton/hr. Furnace volume is 4,642 cu. m. (163,909 cu. ft.) and radiant heat absorbing surface in the furnace is 2,440 sq. m. (26,254 sq. ft.). Heat release in the furnace is 103 × 10^3 Kcal/cu. m./hr. (14,600 B.Th.U./cu. ft./hr.) Total metal weight of the boiler is 2,845-tons. Austenitic material accounts for 25-tons and pearlitic alloy steel material accounts for 721-tons. The heaviest component is the tubular air - preheater which with accessories weighs some 717-tons. The economiser and the transition zone tubing are made of 0.2 per cent. carbon, 32 mm. (1.25 in.) o.d. steel tubing of 3.5 mm. (0.14 in.) wall thickness. The lower radiant tube part is made of 42 mm. (1.65 in.) o.d. tubing of 4.5 mm. (0.18 in.) wall thickness, also of 0.2 per cent. carbon steel. The middle and top parts of the radiant surfaces are of 57 mm. (2.25 in.) o.d. tubing of 4.5 mm. (0.18 in.) wall thickness made of 1 per cent. chromium-0.3 per cent. molybdenum steel with vanadium addition; the ceiling screen is of tubing 57 mm. (2.25 in.) o.d. of the same material, the wall thickness being 7 mm. (0.28 in.). The platen-type superheater is of 40 mm. (1.57-in.) o.d. tubing of 5 mm. (0.20-in.) wall thickness manufactured of the aforementioned material, and of 42 mm. (1.65-in.) o.d. tubing of 4.5 mm. (0.18-in.) wall thickness made of 18 per cent. chromium-12 per cent. nickel with titanium addition. The first stage of the reheater is of 42 mm. (1.65-in.) o.d. tubing of 3.5 mm. (0.14-in.) wall thickness of 1 per cent. chromium-0.3 per cent. molybdenum with vanadium addition, and the second stage is of tubing of the same diameter, but of a steel containing 2.25 per cent. chromium and 0.6 per cent. molybdenum with vanadium and niobium additions. (*O. N. Dobrin and G. Ya. Mezharaup, Teploenergetika*, January, 1959. pp. 28/37.)



Sectional arrangement of a Russian once-through forced-flow boiler.

KEY:—(1) Lower radiant section; (2) Middle radiant section; (3) Upper radiant section; (4) Ceiling tubes; (5) Platen-type superheater; (6) Reheater; (7) Transition zone; (8) Second stage of primary air preheater; (9) Economiser; (10) Secondary air preheater; (11) First stage of primary air preheater.

175-MW extension to Dutch power station

The N.V. Provinciale Noordbrabantse Electriciteits-Maatschappij, Geertruidenberg, have ordered a Schelde-Sulzer Monotube steam generator from the Sulzer licensees for Monotube boiler plants in Holland, the Koninklijke Maatschappij De Schelde, Flushing. The steam generator will have a capacity of 1,125,000 lb./hr. The steam pressure at the boiler outlet is 2,560 lb./sq. in., and the temperature of the high-pressure steam 1,058 deg. F. The steam is supplied to the high-pressure part of a single-shaft condensing turbine rated at 175-MW and is then returned to the boiler to be reheated. The final temperature of reheat is 1,013 deg. F. After leaving the reheater the steam goes to the medium-pressure, low-pressure and condensing

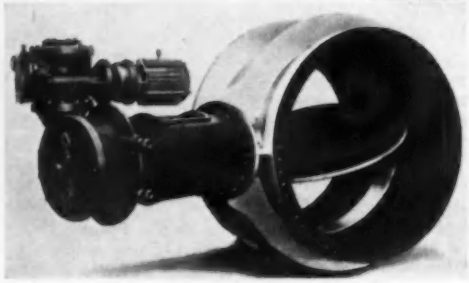
sections of the turbines. The boiler itself and many accessories are controlled by the well-known Sulzer system using oil under pressure. An interesting feature is the Triflux heat-exchanger used for regulating the outlet temperature from the reheater which enables this temperature to be kept constant over a wide range of load. The Triflux system has been developed and patented by Sulzer Brothers and permits loss-free temperature regulation with injection of condensate into the high-pressure circuit. The boiler unit, will be one of the biggest so far installed on the European Continent. The combustion chamber, with a volume of over 140,000 cu. ft. will, the company claim, be the largest so far employed anywhere. Approximately 59-tons of coal will be burnt in the new boiler every hour. The firing system is of the pulverised-coal double-U type with wet pulversing mills. The unit is also equipped with mazout burners with which the full steam output can be raised. (*Sulzer Technical Review*, Vol. 40, No. 2, pp. 81/82.)

ENGINEERING, MARINE, WELDING AND NUCLEAR ENERGY EXHIBITION

Details of the exhibits of a number of firms were received too late for inclusion in our description of the Engineering, Marine, Welding and Nuclear Energy Exhibition in the April, 1959, issue. They are, however, of particular interest to readers of this journal, and for that reason are given below:

J. Blakeborough & Sons Ltd.

This display covered developments in the Blakeborough range of fluid control valves. Prominent amongst the exhibits was a 60-in. bore motor-operated butterfly valve, as supplied for main gas duct service on atomic power reactors. Also for nuclear power applications were examples of bellows-sealed gate and globe valves for radio-active gas conditions on secondary CO_2 circuits; and an 8-in. bore reactor charge-discharge valve, hinged door pattern, with power cylinder operation and interlocking gear, for fuel standpipe mounting. Other exhibits included a 30-in. manually-operated butterfly valve for circulating water and other services; examples of pneumatically-operated diaphragm motor valves for automatic process control; and a demonstration model of power-driven self-cleaning rotary drum screen for water intakes.



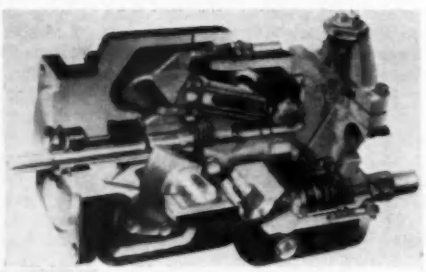
(Left). 60-in. bore motor-operated butterfly valve for main gas duct service on atomic power reactors. (J. Blakeborough & Sons Ltd.)

The General Electric Co. Ltd.

One of the outstanding features of the General Electric exhibit was an alternator fitted with G.E.C. Accurex static excitation. This was designed to illustrate the advantages of quick response and voltage stability as well as the mechanical merits of such equipment. The Accurex exhibit was arranged on the stand so that a number of motors could be started direct-to-line, with varying loads on the alternator, thus representing the type of conditions which might be encountered on board ship when the largest motors are started on a loaded system. Part of the G.E.C. stand displayed a typical lighting scheme for the lounge of a passenger-cargo vessel, while other exhibits include Pirelli-General ship-wiring cables, G.E.C. smoke-detection equipment, and Maxcess fans manufactured by Woods of Colchester Limited, an associate company.

Hunt & Mitton Limited

Hunt & Mitton Limited are now representing in Great Britain the well-known French manufacturers of control instruments and valves, Francel of Paris, and included among the exhibits on this stand were Francel Automotor valves—control valves with integral instruments requiring no external pilot supply. Other exhibits included 600 lb. rating automatically-operated valves for high-pressure hot water at temperatures up to 400 deg. F.; pressure control valves for up to 4,000 lb./sq. in. hydraulic; a remodelled range of renewable composition disc valves; globe valves in bronze up to 300 lb. rating and forged-steel up to 600 lb. rating; and a 900 lb. rating parallel slide valve.



(Above). Cut-away view of a Lucas hydraulic pump—type I.P. 525. Joseph Lucas (Hydraulic and Combustion Equipment) Ltd.

Joseph Lucas (Hydraulic & Combustion Equipment) Limited

New equipment exhibited on this stand included a working demonstration of a pneumatic register with its control console operating, but not burning. Indicator lights showed when the register was igniting, and the air cone and burner assemblies were moved pneumatically when operated from the console. The range of hydraulic pumps and motors manufactured by the company has been extended to include three new units, and these were exhibited for the first time. They all operate at 1,000 r.p.m. and cover capacities of 125, 500 and 1,000 gal./hr. A working demonstration of the Lucas hydrostatic transmission system was given, while other exhibits included a boiler torch igniter; and a range of atomisers covering flows from 0.5 gal./hr. to 5,500 lb./hr. for various applications in oil-fuel burning equipment.

Wellworthy Limited.

On view for the first time was this company's new Spirolox retaining rings, a fixing locating device for securing shafts, bearings, bushes, oil seals, springs, etc. Also displayed were examples of pistons, piston rings, cylinder liners, gland packings, and jointing compound. The Wellworthy-Ricardo positive-displacement-type compressor was also exhibited. Among the special advantages of this compressor are that it provides high torque at low r.p.m., and delivers oil-free air with a non-pulsating constant flow. It is silent, and has high adiabatic and overall efficiency.

Mr. C. L. Jacques, M.I.Mar.E., M.Inst.F., has been appointed chief generation engineer of the Eastern Division of the Central Electricity Generating Board. Mr. Jacques was appointed station superintendent at Barking in 1948 and held this office until 1951, when he was appointed generation engineer (Southern) in the Eastern Division, the post he relinquishes to take up his present appointment.

* * *

Mr. James L. Thomas, Scottish area manager of The Cape Asbestos Co. Ltd., and his staff, have moved to new offices in the Springburn district of Glasgow. Their address is now: Hobden Street, Petershill Road, Glasgow, N.1 (telephone no.: Springburn 6144). All Scottish enquiries concerning "Caposite" and "Rocksil" thermal insulation materials and "Capasco" brake linings and clutch facings should be made to this new address. This is also the new address of Mr. A. Armour Clark, Scottish area representative of Cape Building Products Ltd., subsidiary of Cape Asbestos and manufacturers of "Asbestolux" and Uxbridge flint bricks.

Latest Power Plant Patents

These extracts from British Patent Specifications are reproduced by permission of The Controller of H.M. Stationery Office. (Complete British Specifications can be obtained from the Patent Office, 26, Southampton Buildings, London, W.C.2. Price 3s. 6d. each, both inland and abroad.)

Steam generator and superheating plant for nuclear plant

An object of this invention is to provide for the superheating of steam from a low-pressure source, and for the continuation of a supply of superheated steam to another supply when the supply of steam from the low-pressure source is discontinued. The invention is of particular importance regarding the supply of highly-superheated steam from low-pressure sources heated by means of heat from nuclear reactors, and generating steam at pressures, for example, of the order of 350 to 600 lb./sq. in. abs. The unit comprising the high-pressure steam-generating means and the superheating means as shown in Fig. 1 is particularly applicable to a power plant having a dual-pressure stage steam turbine, a low-pressure stage of which receives 1,100 deg. F. steam at a low-pressure, such as 350 to 600 lb./sq. in. abs., generated by heat from a nuclear reactor, and the high-pressure stage of which receives relatively high-pressure steam. The normal operation of this unit involves the flow of steam at a pressure of, perhaps, from 350 to 600 lb./sq. in. The flow of steam continues through the different stages of superheating from the initial superheating in the heat-exchanger (16), while the subsequent superheating stages are effected in the gas-heated superheater components subject to the heat of the gases originating in the cyclone furnace (130). The steam superheated to a temperature of the order of 1,100 deg. F. passes to one stage of a dual stage steam turbine for producing power. However, to provide for a supply of steam from the unit to the turbine for power generation purposes when the nuclear reactor is shut down, means are provided for passing the steam generated in the steam-generating section of the unit directly to the gas-heated superheater components, and thence to the turbine. This means involves the conduit (250) arranged to conduct steam from the drum (20) to the superheater inlet header (40). As shown in the diagram, the conduit (250) leads from the conduit (18) at a position between the drum (20) and a valve (252) which is closed when the nuclear reactor is shut down. Under these circumstances, a valve (254) in the conduit (34), and a valve (256) in the conduit (38) are closed, and the valve (258) in the conduit (250) is open. Under these circumstances, the pressure of the steam leaving the drum (20) is reduced to a pressure corresponding to the normal

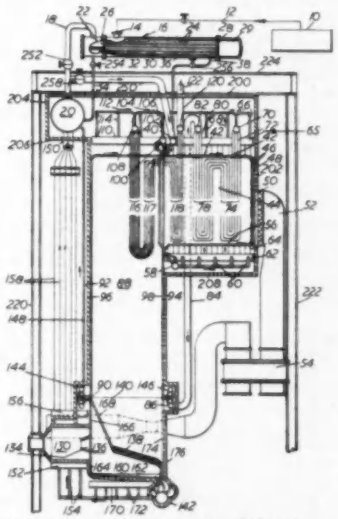


Fig. 1. British Patent No. 809,240.

pressure of the steam leaving the nuclear reactor. In addition to providing for the production of power when the nuclear reactor is shut down, the method of operation provides for advantageous utilisation of non-radio-active steam generated by the unit. This steam may act as a washing agent to wash out or dilute radio-active deposits in the superheaters, turbine, condenser and feedwater heater. It also decreases the risk of oxygen pick-up in the system and resulting corrosion, and thereby provides for a substantial saving in the original cost of the system, in that carbon steel may be used in place of stainless-steel for the feedwater heaters and associated equipment. When the steam from the fuel-fired generator passes to the turbine, the furnace-wall steam-generating tubes are supplied with feedwater at an appropriate temperature. This end may be attained by the use of a convection economiser interposed between the air-heater (54) and the convection superheater; the flow of feedwater from the economiser being directed to the nuclear steam generator when the superheaters receive only steam from the latter generator. *British Patent No.* 809,240 *issued to Babcock & Wilcox Limited. Complete specification published February* 18*th*, 1959.

Automatic feedwater control of forced flow boiler

This invention relates to an automatic feedwater control system for forced-flow boilers. Perhaps the most important problem still to be solved in the use of this boiler type is the problem of control, and particularly the problem of automatic control. In consequence of the absence of the drum incorporated in the natural-circulation boiler, the sharp separation between the evaporating section and the superheating section of the system has disappeared. The zone in which evaporation begins is no longer fixed, but moves in dependence on changes of load in a direction towards the boiler inlet or outlet. A further difficulty is that, due to the low water capacity of the boiler system, brickwork and lining exert a considerable influence on the processes taking place within the boiler tubing; that is preheating, evaporation, superheating. Any boiler control must satisfy the requirement of adjusting the rate of supply of the water, fuel and air with respect to the existing boiler load. However, the quantitative adjustment of these three media to the existing working condition is not sufficient, since the influence of the thermal capacity of the system on the heating processes cannot thus be taken into consideration. In Fig. 2 is shown a diagrammatic circuit drawing of the boiler system to which the control system claimed in this patent is fitted. The boiler system includes successive stages (S_{sp1}, S_{sp2} and S_{sp3}), through which the water is forced to circulate from a boiler input in the vicinity of the first stage (S_{sp1}) to the boiler output (D) in the vicinity of the

final stage (S_{Sp4}). A pressure-sensitive element (not shown) is placed in the vicinity of the boiler output (D) in the live steam pipe, and a signal (X_D) representative of the pressure (P) at this point is fed from this element to a pressure controller (R_D) from which is derived a variable output signal (Y_D) which varies in response to variations in the boiler pressure, the controller (R_D) being provided with a feedback arrangement (R_F). This variable output signal (Y_D) is fed to a load

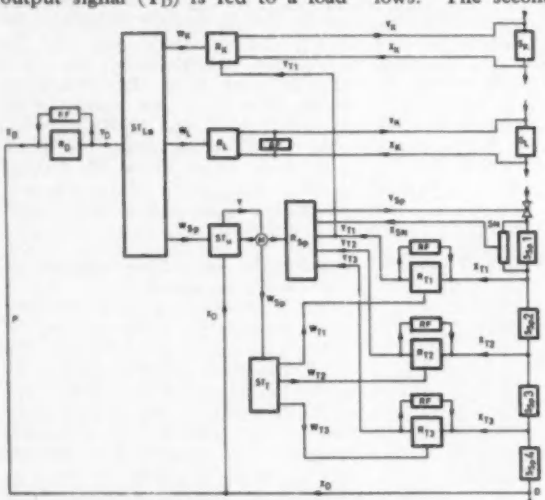


Fig. 2 (left). British Patent No. 809,287.

setting device (ST_{La}) and serves to control the magnitude of output signals (W_K, W_L and W_{Sp}), derived from this device and fed respectively to a coal supply regulator (R_K), an air supply regulator (R_L) and, via a follow-up controller (ST_U) to a feedwater regulator (R_{Sp}). The stage (S_{Sp1}) is provided with a main temperature controller (RT_1), to which is fed a temperature dependent signal (X_{T1}), which is characteristic of the temperature of the water at the outlet end of the stage (S_{Sp1}), as detected by a temperature sensitive element (not shown) placed at this point. The arrangement described so far is designed to control the feedwater supply to the input of the boiler so as to correct for any undesirable temperature variation in or around the outlet of the first stage (S_{Sp1}). It will be appreciated, however, that should this compensatory control at the outlet of the first stage fail to operate or, alternatively or additionally, if other undesirable temperature variations take place in the vicinity of any of the succeeding stages that are downstream in the direction of the boiler system, a cumulative effect will occur which will not be compensated for by any variation in the feedwater supply at the input to the boiler. Thus, for example, if a 1 per cent. temperature deviation occurs at the first stage (S_{Sp1}) and this is not compensated for, then this 1 per cent. deviation will result in a 10 per cent. temperature deviation in the last stage (S_{Sp4}). In the past such cumulative temperature deviations have been compensated for by the injection of water at the boiler outlet. In the present arrangement, however, the cumulative deviations are corrected as follows. The second and third stages

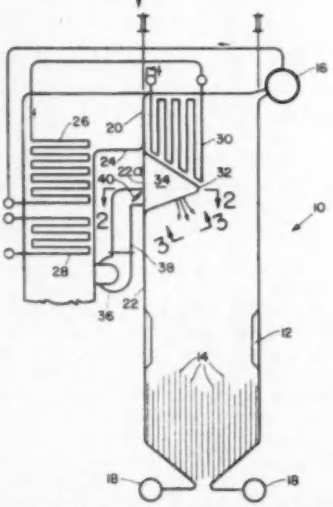


Fig. 3 (below). British Patent No. 809,667.

(S_{Sp2} and S_{Sp3}) are each respectively associated with auxiliary temperature controllers (R_{T2}) and (R_{T3}). To the controllers are fed temperature dependent signals (X_{T2} and X_{T3}) which are respectively characteristic of the temperatures of the water at the outlet ends of the second and third stages, the temperatures being detected by temperature sensitive elements (not shown). These elements are placed at the outlets of the second and third stages. A temperature reference signal (W_{T2}) is fed to the auxiliary temperature controller (R_{T2}) from the reference temperature setting device (ST_T). This temperature reference signal (W_{T2}) corresponds to the desired temperature at the outlet of the second stage, which temperature is determined by the load. Similarly, a temperature reference signal (W_{T3}) is fed from the reference temperature setting device (ST_T), this temperature reference signal (W_{T3}) corresponding to the desired temperature at the outlet of the third stage. In a similar manner to that described for the main temperature controller, resultant temperature signals (Y_{T2}) and (Y_{T3}) are respectively derived from the auxiliary temperature controllers (R_{T2} and R_{T3}) and are respectively fed back to the feedwater regulator (R_{Sp}). The resultant temperature signals (Y_{T2} and Y_{T3}) correspond to the deviations at the respective outlets of the second and third stages between the desired and actual temperatures. *British Patent No. 809,287 issued to Siemens-Schuckertwerke A.G. Complete specification published February 18th, 1959.*

Steam generator

The steam generator shown in Fig. 3 comprises a furnace (10) into the lower portion of which fuel and air are introduced through burners positioned at (12). The inner surface of the walls of the furnace (10) are lined with adjacent, vertically placed steam generating tubes (14) which form a portion of the steam generating circuit of the generator and communicate at their upper ends with steam and water drum (16) and at their lower ends with one of the headers (18), with these headers being connected with drum (16) through a downcomer or downcomers, (not shown). The combustion gases pass from the furnace (10) through the outlet opening (20) provided at the upper end of the rear wall (22) of the furnace. This opening extends across the entire width of the wall. After passing from the furnace the gases are conveyed through duct (24) within which are positioned various convection heat-exchange surfaces of the boiler, such as the low-temperature superheater section (26) and the economiser section (28). The steam generated, which is separated in drum (16), is superheated by being passed first through the low-temperature superheater section (26) and then through the high-temperature section (30). The latter is placed at the upper end of the furnace immediately above the nose baffle (32)

so that it is shielded by this baffle from a major portion of the radiant heat within the furnace. Combustion gases are introduced into the duct (34) formed by baffle (32) and wall portion (22a) by means of the motor-driven fan (36). The inlet of this fan communicates with duct (34) at a location downstream of economiser (28) relative to the combustion gas flow, and with an outlet which communicates with duct (34) through the gas conduit (38) within which is placed the adjustable damper (40). The tubes of wall portion (22a) immediately adjacent each side of conduit at the location where this conduit is connected to this wall portion have their fins removed and are bent laterally to form an opening for this connection. When the gas recirculation system is not in operation, damper (40) is closed to prevent the reverse flow of gases through conduit (38) from furnace (10) to the lower portion of duct (24) and thus protects the fan (36) from being overheated. When it is desired to recirculate gases, however, in order to reduce the mean temperature of the combustion gases which scrub the upper portion of the tubes lining the furnace and pass over the various convection heat-exchange surfaces, fan (36) is started and damper (40) is partially or fully-opened. The amount of, and rate at which these gases are recirculated may be controlled by controlling the speed of fan (36), or controlling the position of damper (40), or by both of these methods. *British Patent No.* 809,667 *issued to Combustion Engineering Inc. Complete specification published February 25th,* 1959.

Following the recent retirement of **Mr. S. Hoggart,** M.I.E.E., divisional transmission engineer, South Western Division, C.E.G.B., and pending the result of investigations into the possibility of merging the Divisional Transmission and Technical Departments, as a temporary measure, **Mr. W. H. Campbell,** M.I.E.E., senior assistant transmission engineer (construction) since 1948, has assumed control of the Transmission Department from April 1st, 1959, and while doing so will be styled "acting transmission engineer."

* * *

Midland Heating & Ventilation Co. Ltd. have appointed **Mr. A. G. Palmer,** 29, Rotherfield Road, Carshalton, Surrey (telephone: Wallington 6829), as their sales engineer for London and the southern counties.

* * *

Mr. D. M. Cherry, B.Sc., M.I.E.E., has been appointed transmission plant and equipment design engineer at the headquarters of the Central Electricity Generating Board to fill the vacancy created by the resignation of Mr. A. J. Gibbons. Mr. Cherry joined the operation department of the former Central Electricity Board, and in 1946 became switchgear engineer in the technical and research department of the Board. He remained in this capacity when this department became the transmission design branch of the B.E.A. and its successors, and was responsible for the development of standardised substation layouts in the post-war construction period. In 1954 he became the substation plant engineer in the transmission design branch.

* * *

Charles Winn & Co. Ltd. announce that **Mr. W. J. Cockering,** A.M.I.-H.V.E., has joined their sales staff, and has taken up his duties as technical sales representative in the Birmingham/Coventry/Leicester area. Mr. Cockering will operate from the head office and works of the company at Granville Street, Birmingham, 1.

* * *

Publication No. 5014 issued by **Sturtevant Engineering Co. Ltd.,** Southern House, Cannon Street, E.C.4, describes the company's "Six-×-Three" industrial vacuum cleaner. Although of comparatively small overall dimensions, this unit has been designed to provide a large volumetric output, and high working suction.

The **Central Electricity Generating Board** propose to investigate five areas in the East Midlands to ascertain their suitability as sites for coal-fired power stations. They are at Ratcliffe-on-Soar, Holme Pierrepont, Market Warsop, Cottam and West Burton. Ground surveys and trial borings will be made, and it is expected that the investigation will take several months to complete. The East Midlands coal field is the largest producer in this country of the low-grade coal used for electricity generation, and output is expected to increase in the future. Coal-fired power stations already working or planned near the East Midlands coalfield include Drakelow "A," "B," and "C" stations (ultimate capacity 2,220-MW), Willington "A" and "B" stations (800-MW), Castle Donington (600-MW), Staythorpe "A" and "B" stations (720-MW) and High Marnham (1,000-MW). The purpose of a further station is to absorb future coal production close to the source and help to keep pace with the growing demand for electricity both locally and further afield. Generating capacity will depend upon the facilities offered by the sites to be examined, and may well be 1,000-MW corresponding to a coal consumption of three million tons per annum, or more. Any power station proposal arising from these investigations will be subject to the consideration and approval of the Minister of Power and the Planning Authority.

* * *

At the recent Factory Equipment Exhibition, **Spencer - Bonecourt-Clarkson Limited** showed full-scale units from their range of boiler equipment. These included the "Steambloc" No. 90, Mk. 2, super-Economic, automatic oil-fired "packaged" boiler for industrial steam and hot-water supply, fitted with "Fireye" automatic control; and the Clarkson "Bato/65" fully-automatic oil-fired "packaged" thimble-tube boiler rated at 575 lb./hr. at a working pressure of 120 lb./sq. in. The range of "Steambloc" boilers is, we are informed, being extended by three larger units when the capacities covered will be from 1,500 to 25,000 lb./hr.

* * *

Two new leaflets available from **Crofts (Engineers) Ltd.,** Thornbury, Bradford, 3, Yorkshire, describe small power worm-reduction gears (Publication 5826), and "Ritespeed" motorised conveyor pulleys (Publication 5911).

Stewarts and Lloyds Limited have recently negotiated two contracts with Russia—one for £460,000 worth of boiler and steam tubes, and the other for £383,000 worth of oil-well tubing for the Russian oil industry. Much of the tonnage involved (5,500 tons for the first contract and 4,100 tons for the second) will be produced at Stewarts and Lloyds' works at Corby. Together these two contracts constitute by far the largest order received by the company from the U.S.S.R. since before World War II.

* * *

Cambridge Instrument Co. Ltd. recently issued a new publication (List 144/A) entitled "Gas Analysers—General Principles." This 16-page publication deals with some of the technical problems associated with gas analysis by the thermal conductivity method. It gives performance data on the Cambridge Katharometer, and includes notes on the types of measurement available and on the possible sources of error.

* * *

Three new designs have recently been added to the **Auto-Klean Strainers Limited** range of self-cleaning filters for liquids. These operate on the principle of defined mesh edge filtration, are of all-metal plate-type construction, and are cleaned without interrupting the liquid flow. They are supplied in a range of filtering meshes from 0.001-in. upwards, and magnetic elements are incorporated in each model to give added protection against damage to plant and equipment by ferrous particles. The new range of filters handles flows up to a maximum of 4,000 gal./hr. The address of the company is Lascar Works, Hounslow, Middlesex.

* * *

An entirely new edition of the Crabtree Electrical Handbook has been issued by **J. A. Crabtree & Co. Ltd.,** Walsall, Staffs. The introduction of new wiring materials and methods; the appearance of many new British Standards; changes in regulations; the extensive developments in Crabtree wiring accessories and protective and automatic control gear—are all reflected in this edition. A number of sections have been added and the reference tables have been expanded. As a result, the handbook now comprises 424 pages. This edition is published at the nominal price of 5s. net, and may be obtained through booksellers or from the head office of the company at Lincoln Works, Walsall, Staffs.

NOTES Personal AND Industrial

At the annual general meeting of International Combustion (Holdings) Limited, held in London on March 24th, **Mr. G. R. T. Taylor** was elected as the first President of the company. Mr. Taylor has served the company for over 35 years and was chairman until 1957.

* * *

Sir Ashley S. Ward, LL.D., the well-known Sheffield industrialist, died on March 26th, at the age of 81, after a short illness, in a London hospital. Sir Ashley was president of Thos. W. Ward Limited, Albion Works, Sheffield, chairman of the Park Gate Iron & Steel Co. Ltd., Rotherham, vice-chairman of Laycock Engineering Co. Ltd., Sheffield, and a local director of the National Provincial Bank Limited. He became successively assistant managing director, joint managing director, and in 1941 was appointed chairman and managing director of Thos. W. Ward Limited, on the death of Dr. Joseph Ward, J.P., a younger brother of the founder of the firm. He continued in this office until 1950, when he was appointed the first president of the company, a post he held up to the time of his death.

* * *

Sir Ernest Lever has retired from the board of Richard, Thomas & Baldwins Limited, after nearly 19 years as chairman and director. **Mr. G. C. R. Eley** has been appointed chairman in his place.

* * *

Mr. V. A. Pask, C.B.E., M.Inst. C.E., M.I.Mech.E., M.I.E.E., has been appointed managing director, and **Mr. W. V. Wright,** sales director, of John Brown Land Boilers Limited.

* * *

Mr. D. C. Dunn, B.Sc.(Eng.), M.Sc., Assoc. Inst. Mech.E., F.Inst.F., has been appointed chief engineer to Cochran & Co., Annan, Ltd. Mr. Gunn was formerly deputy-director of Industrial and Domestic Research Laboratories, British Coal Utilisation Research Association, Leatherhead.

* * *

Dr. E. W. F. Gillham, M.Sc., Ph.D., F.R.I.C., formerly divisional chief chemist, East Midlands Division, has been appointed research and development officer for the Midlands and East Midlands Region of the Central Electricity Generating Board. From 1948-1950 Dr. Gillham was group chemist to the London Division of the former Central Authority, and from 1950-1952 was seconded to Central Authority Headquarters for work on boiler corrosion. In 1952 he was appointed chief chemist to the East Midlands Division. While at Fulham, Dr. Gillham was closely associated with the development of the Fulham/Howden system of flue-gas washing at the Fulham station, and more recently has been closely associated with the pilot flue-gas washing plant at Nottingham power station.

Sir Alexander McColl, chairman of the Superheater Co. Ltd. for 15 years, has at his own request retired from the board. He had been a director for over 35 years and is to be succeeded as chairman by **Mr. Eric A. Robinson,** M.C., who will also retain his position as managing director of the company.

* * *

Mr. R. A. Kirkby has succeeded Sir Ronald W. Matthews as chairman of General Refractories Limited, and **Mr. J. Gregory,** production director, will take up the position of managing director in June. It is also announced that **Mr. B. Eichler,** director of research, has been appointed to the board.

* * *

Mr. W. G. Picton, a director of International Combustion Products Limited, has been elected president of the Mechanical Handling Engineers' Association. He has been with International Combustion Products for 32 years, for 22 of which he has been manager of the Materials Handling Division.

* * *

Mr. M. H. Shepheard, B.Arch., A.R.I.B.A., has been appointed architect on the staff of the Central Electricity Generating Board, in the chief design and construction engineer's department at the Board's headquarters. His duties are to advise the Board on the architectural aspects of their activities which include the construction of new power stations, switching stations and transmission lines.

* * *

It is with regret that we record the sudden death of **Mr. B. J. Terrell,** M.B.E., B.Sc. (Eng.), on Friday, March 20th, 1959, at the age of 42, in London, where he was attending a meeting. At the time of his death Mr. Terrell was the chief designer (future projects) of the Parsons and Marine Engineering Turbine Research and Development Association. He was educated at Truro Cathedral School, and at Rugby College of Technology and Arts. He served an engineering apprenticeship in the Rugby Works of the British Thomson-Houston Co. Ltd. In 1938, Mr. Terrell joined the English Electric Co. Ltd. as an assistant steam turbine design engineer. After military service during the war, he joined the staff of the Parsons and Marine Engineering Turbine Research and Development Association at Wallsend-on-Tyne, on the research side, transferring from the position of senior research engineer to senior designer in 1954. In March, 1958, he took up the position of chief designer (future projects), the position which he held at the time of his death.

* * *

It is with regret that we record the recent death after several months' illness, of **Mr. G. A. Adams,** sales manager, Engineering Services Division, of Geo. Salter & Co. Ltd., West Bromwich.

Mr. R. A. Senior has been appointed director and manager of John Thompson Instrument Company, of Wolverhampton. He joined the company 12 months ago to fill the newly-created post of sales manager, and since then, the company has doubled its manufacturing range and has entered the temperature control field of instrumentation. For a number of years Mr. Senior was Midlands area manager for Messrs. Kelvin and Hughes, of London. A second appointment identified with the expansion of the John Thompson Instrument Company is the transfer of **Mr. C. S. Gilbert** from Wolverhampton to Manchester, as sales engineer for the North of England. At Sunlight House, Quay Street, Manchester, Mr. Gilbert will be available to advise on all aspects of instrumentation and automatic control.

* * *

Mr. G. B. R. Fielden, M.A., M.I.Mech.E., engineering director of Ruston and Hornsby Limited, has been elected to Fellowship of the Royal Society.

* * *

Elliott-Automation Limited announces that it has formed a new subsidiary company, **The Swartwout Co. Ltd.,** to manufacture and sell the all electronic control systems for the process industries, heating and ventilating and for power station instrumentation (both atomic and conventional) developed by The Swartwout Company of Cleveland, Ohio. Elliotts entered into an agreement with the American Swartwout company two years ago. Since then, business in Swartwout systems, which are sold in America under the trade name "Autronic," has so expanded that Elliotts have found it desirable to form this new company to handle it, particularly in the export field.

* * *

Mr. W. A. Hartop, managing director, George Kent Limited, is now making an extensive ten-weeks' business tour covering much of South Africa and the Federation of Rhodesia and Nyasaland. His itinerary for this visit is designed not only to further export sales interests, but also to strengthen by personal contact and discussion the close relationship which has always existed between the parent company and the many business interests of George Kent (S.A.) (Pty.) Ltd., of Johannesburg, and also of the Kent Branch in Salisbury, S. Rhodesia.

* * *

Specification No. 301, published by **Jones, Tate & Co. Ltd.,** Victory Works, East Parade, Bradford, 1, Yorkshire, describes their Series-319 solenoid-operated, semi-balanced valves—a range of heavy-duty globe pattern valves designed for the control of fluids, including gases in industrial processes. Standard valves are from ¼ to 4-in. bore for pressures from vacuum to 200 lb./sq. in. Special valves are available for pressures up to 2,000 lb./sq. in., or elevated temperatures, including superheated steam.

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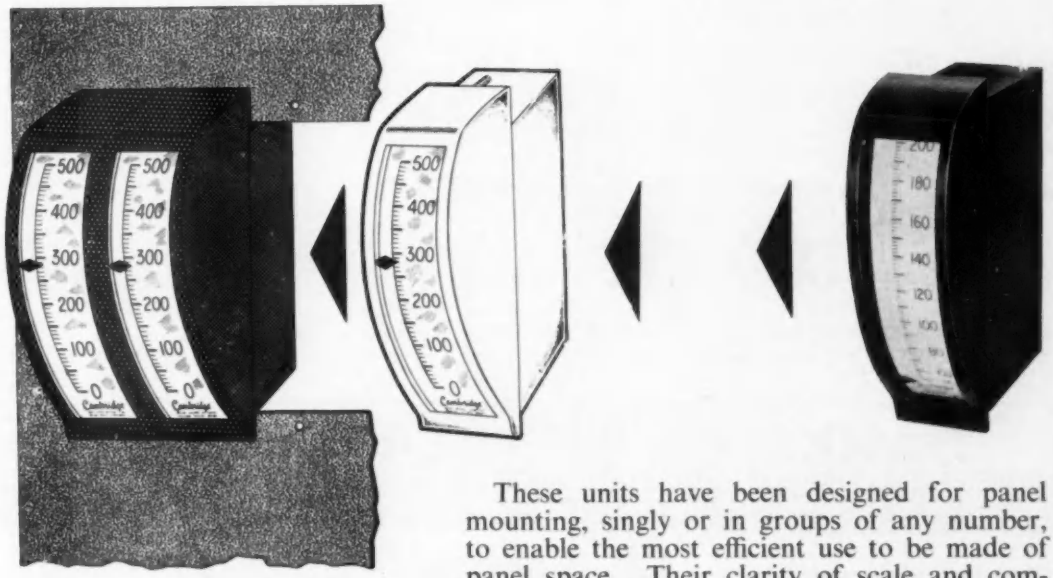

The indicators are available for temperatures up to 1,000° F., for draught measurements up to 60 inches Water Gauge, and for pressures up to 2,500 lb. per square inch.

These units have been designed for panel mounting, singly or in groups of any number, to enable the most efficient use to be made of panel space. Their clarity of scale and compactness allows them to be placed, at the top of the panel, where other instruments cannot easily be read. If necessary, a unit can be removed and replaced without disturbing neighbouring instruments. They can be applied to temperature, pressure and draught measurements and a small number of these instruments can give, in a limited space, a comprehensive display of most of the parameters in an industrial process, or in a boiler house.

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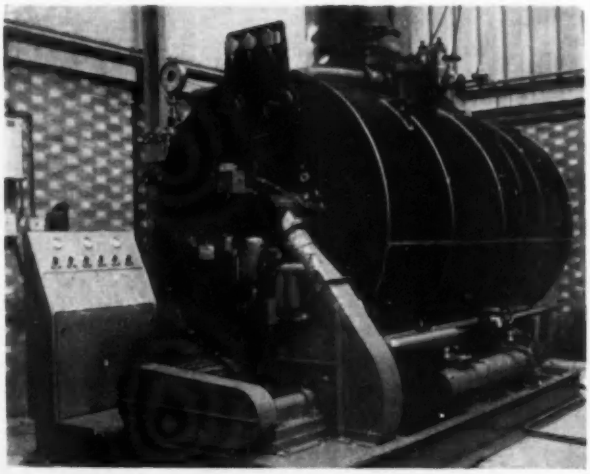

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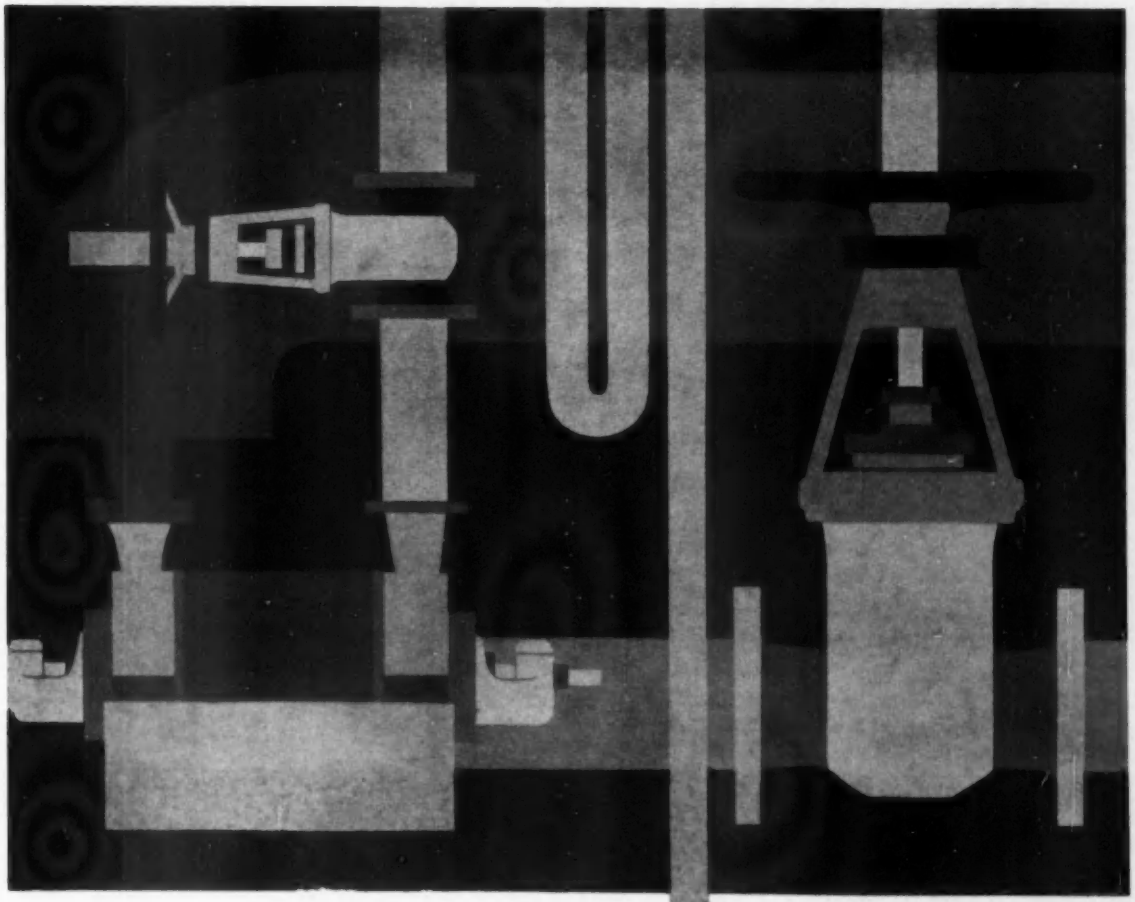

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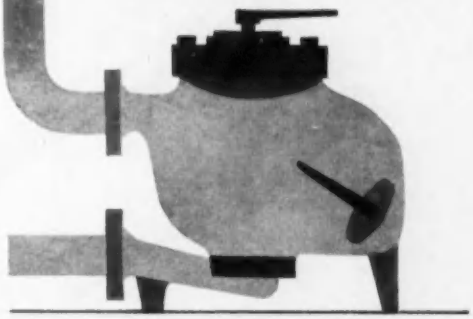

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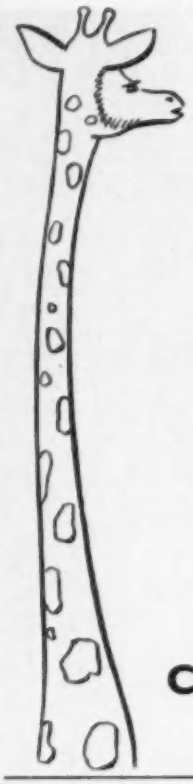

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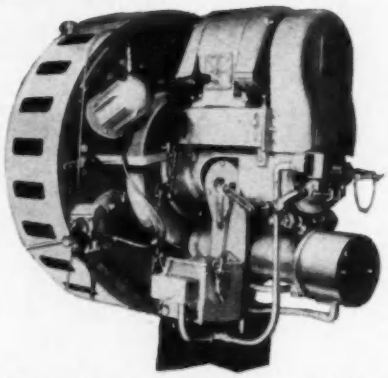

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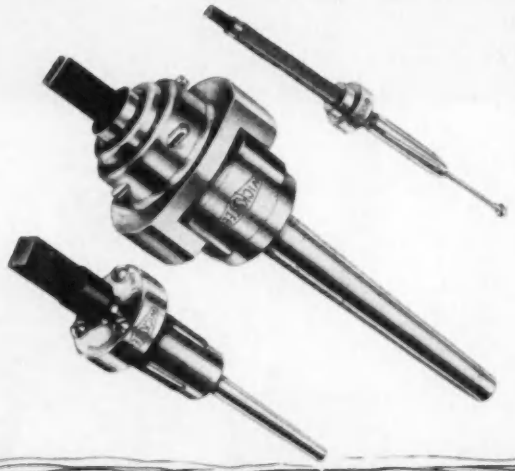

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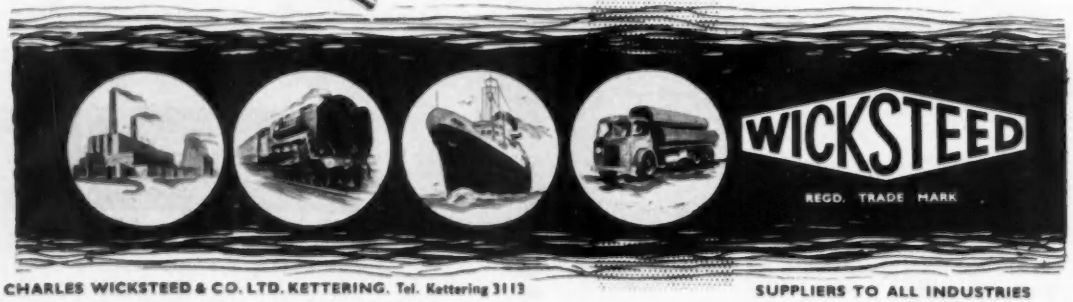

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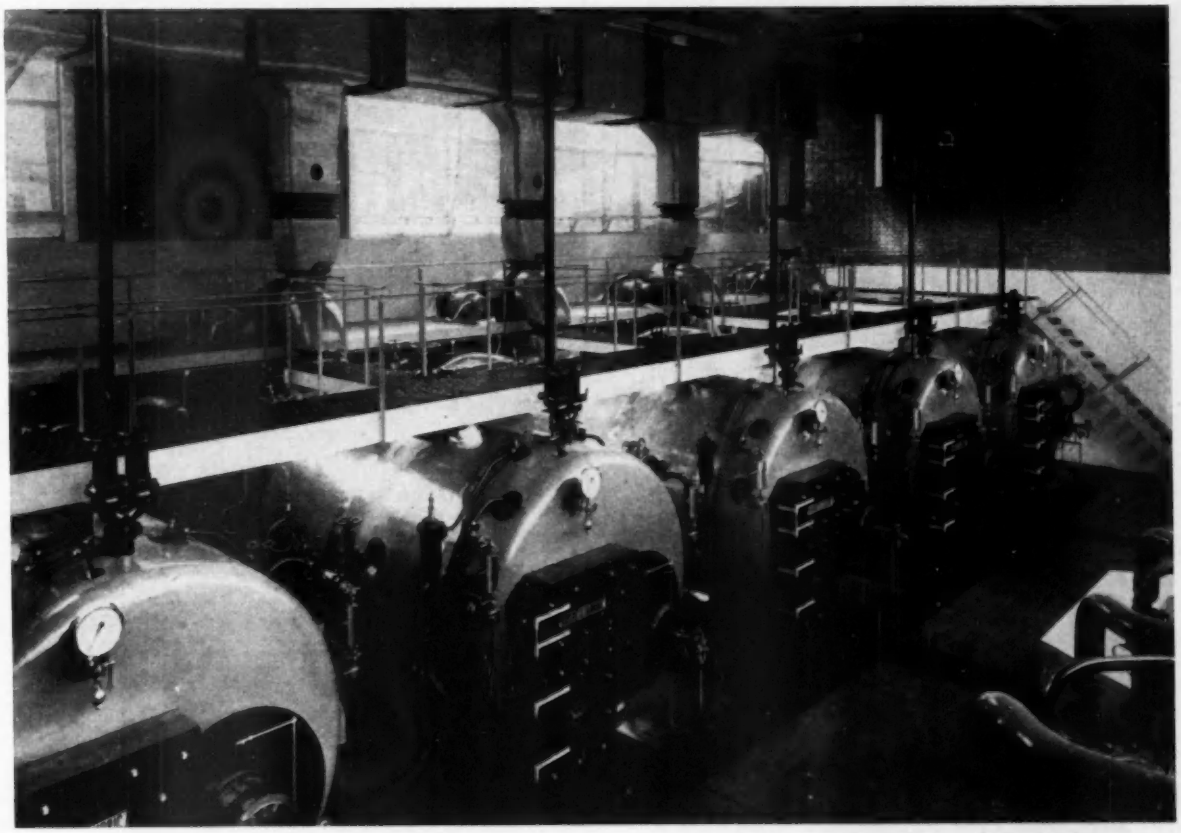

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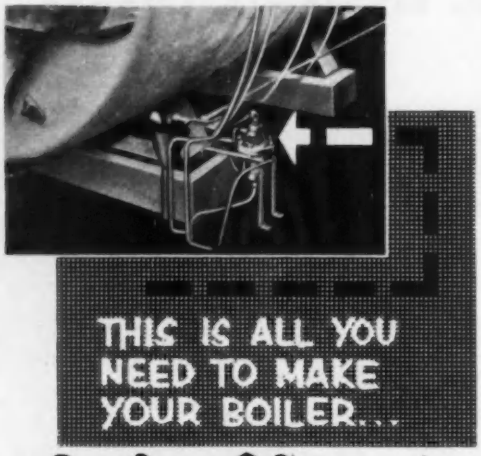

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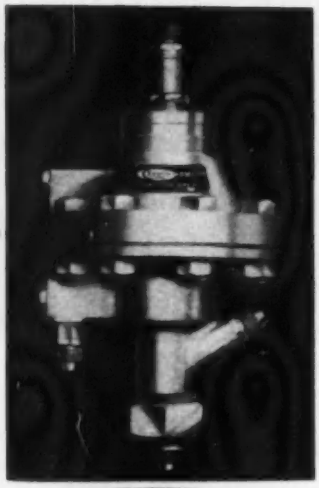

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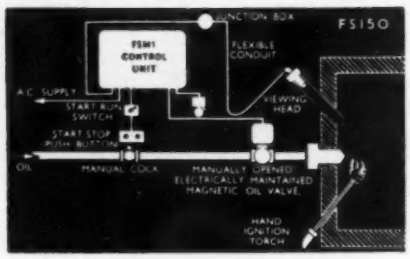

Scheme FS150—FSP1 Unit

For heavy oil burners lit by a manually inserted torch. Owing to the possible viscosity of the oil, a manually opened electrically maintained magnetic oil valve is used. Temporary overriding of the flame failure control is provided whilst starting, with bell muting, by means of the Start/Run switch. The switch cannot be left in the Start position as the alarm re-appears on flame establishment. It is once more muted by switching to the Run position and then gives alarm and shut down on subsequent flame failure.

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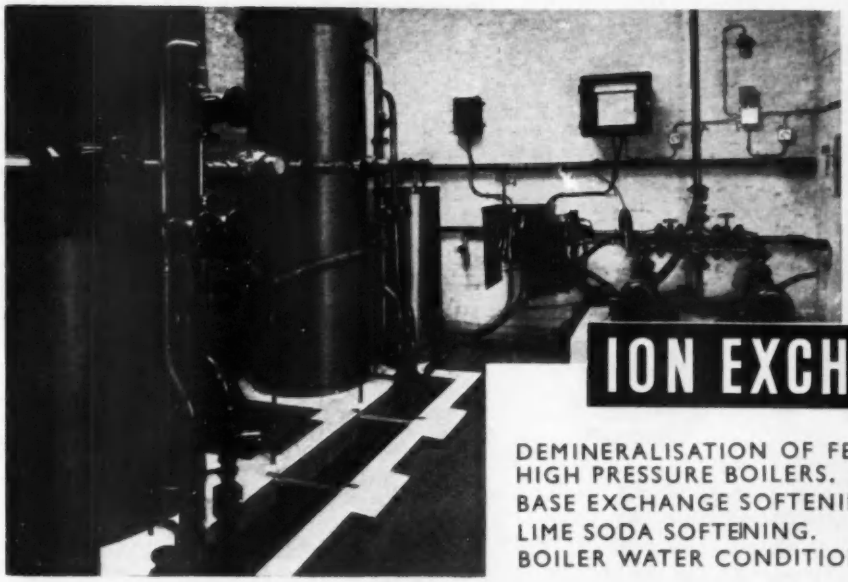

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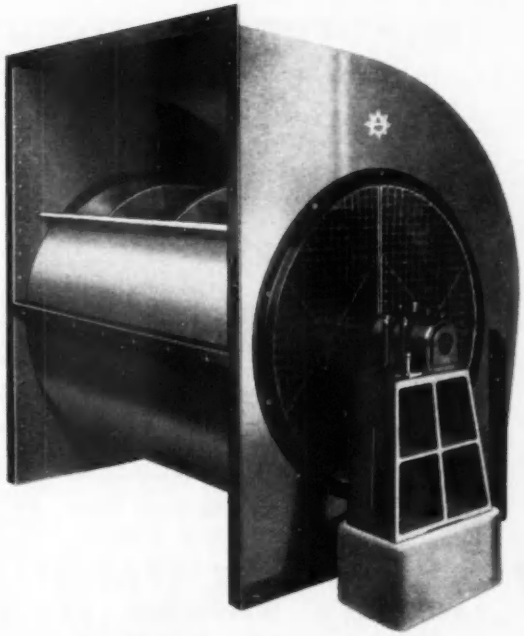

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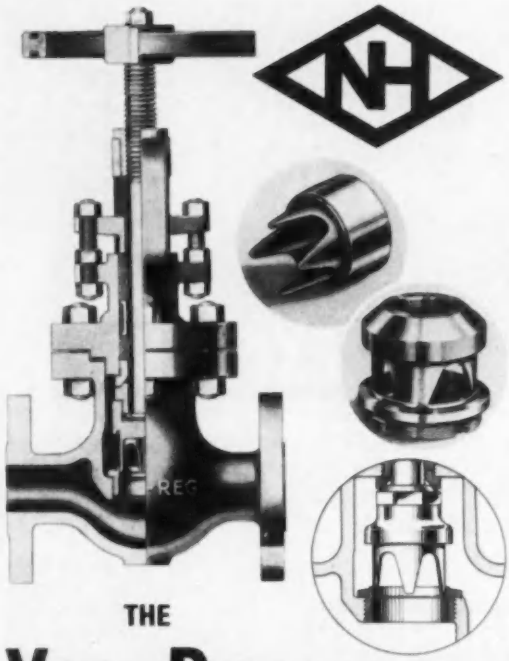

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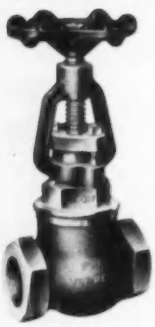

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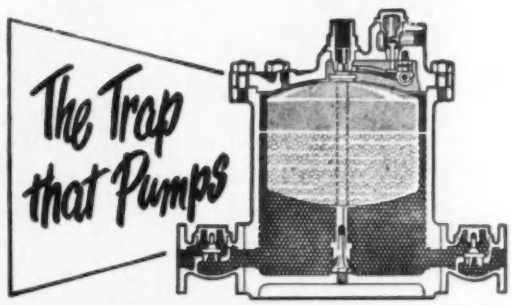

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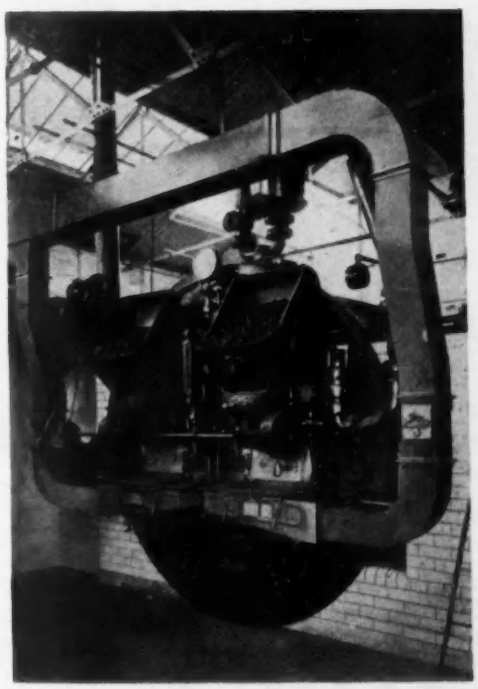

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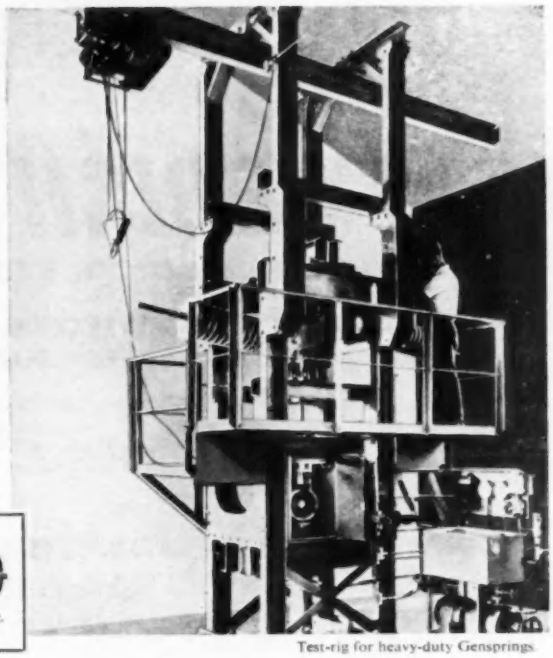

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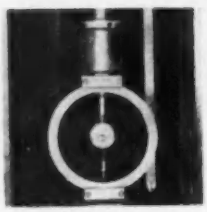

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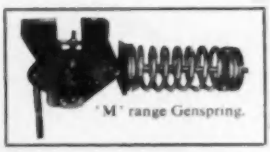

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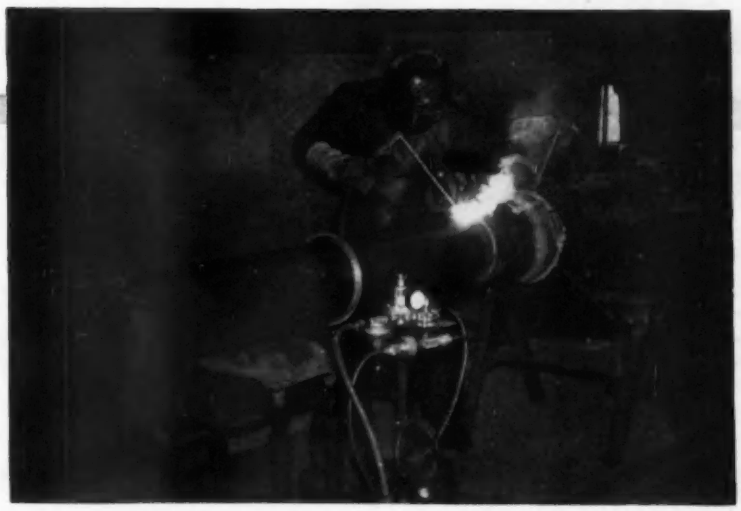

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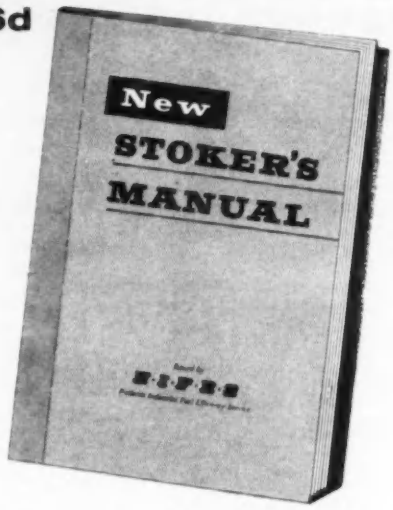

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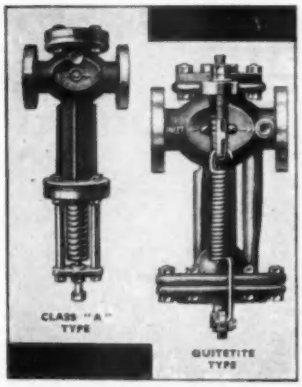

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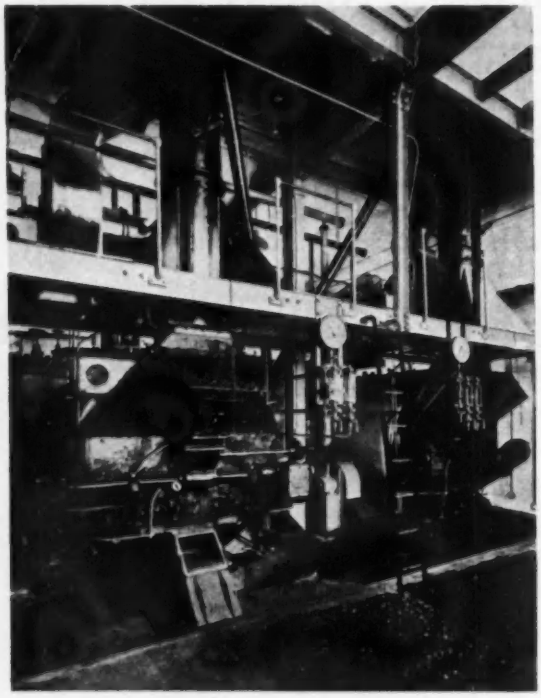

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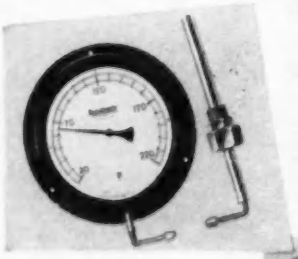

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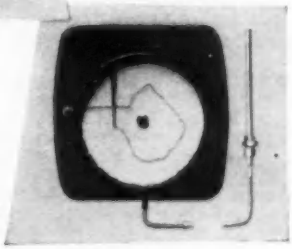

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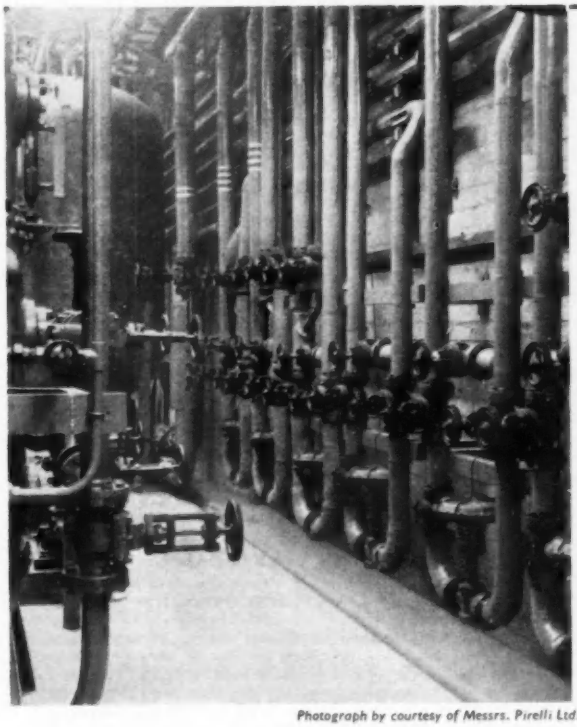

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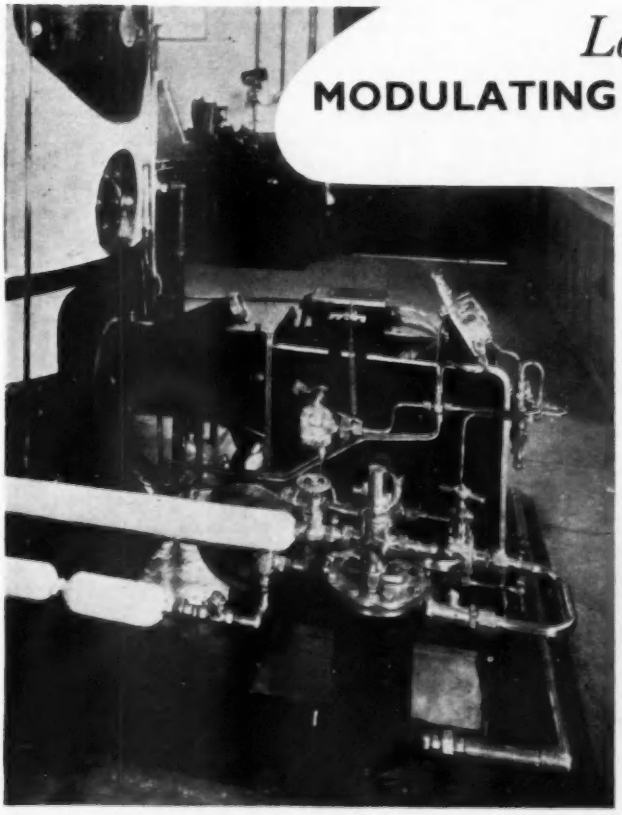

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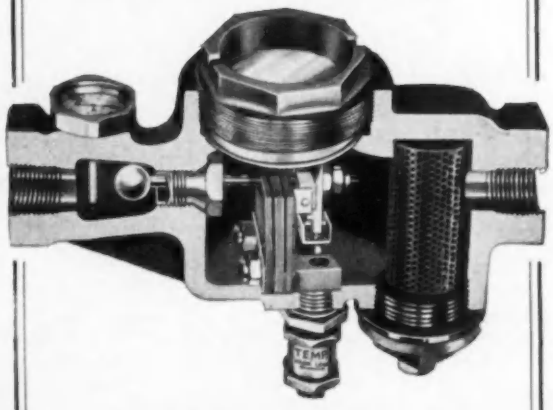

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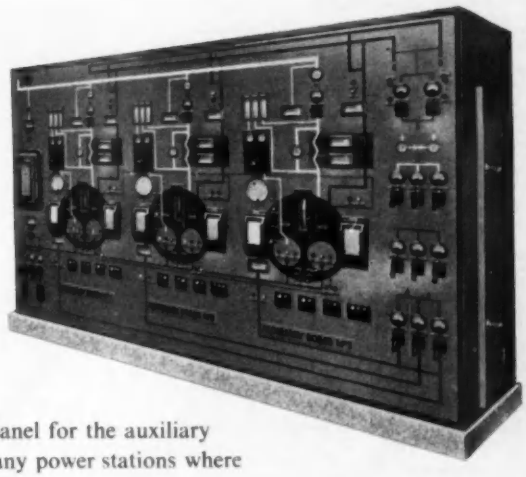

The illustration shows the control and instrument panel for the auxiliary boilers at the Tilbury Power Station, one of the many power stations where Gordon equipment and Elliott Instruments are used

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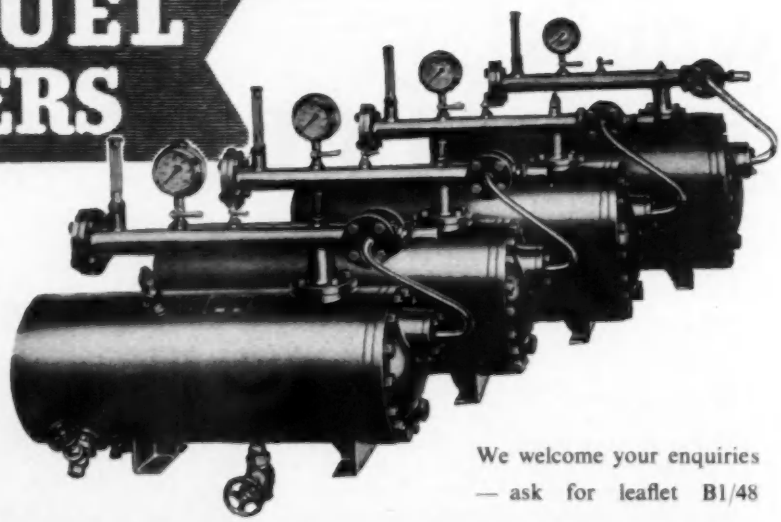

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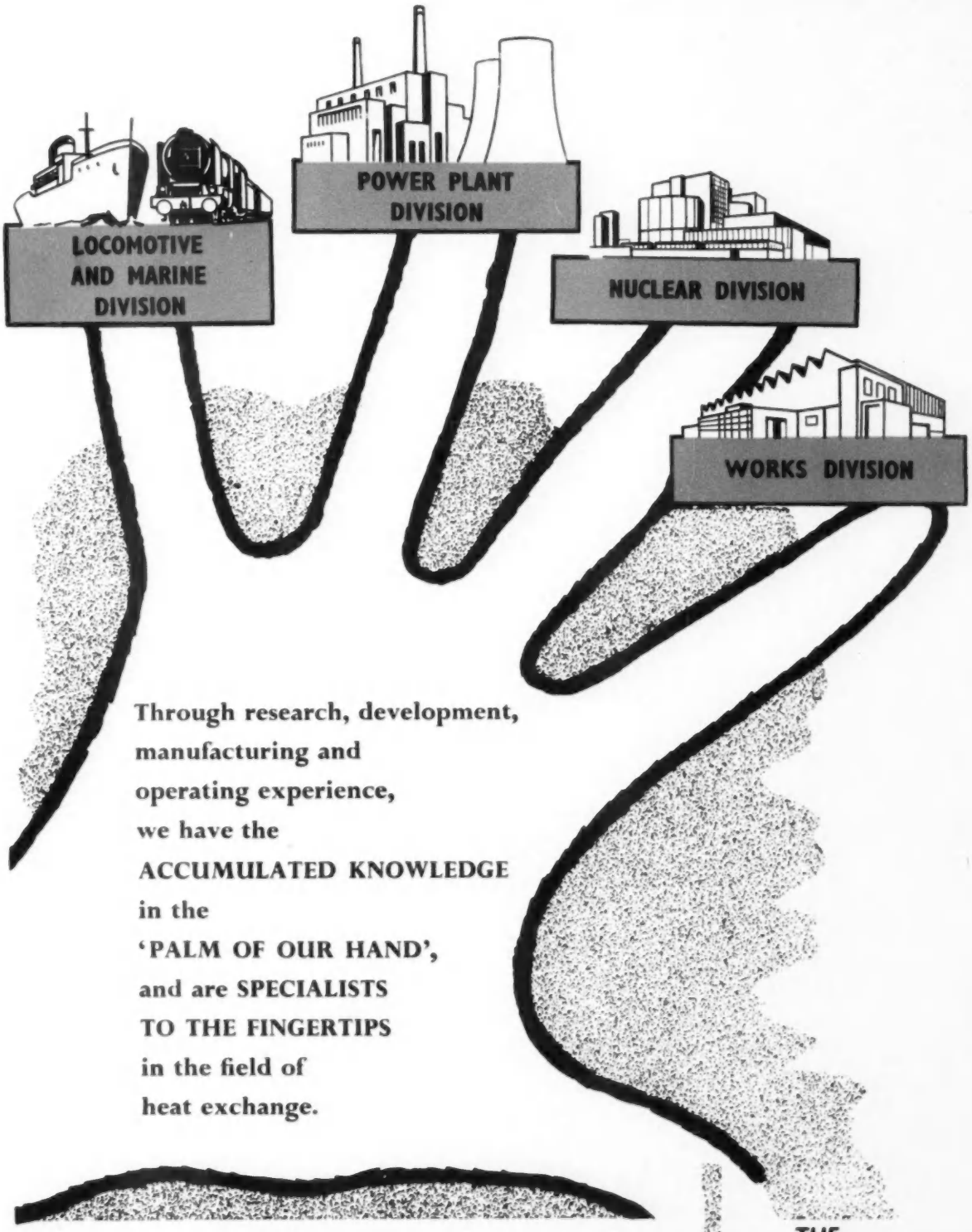

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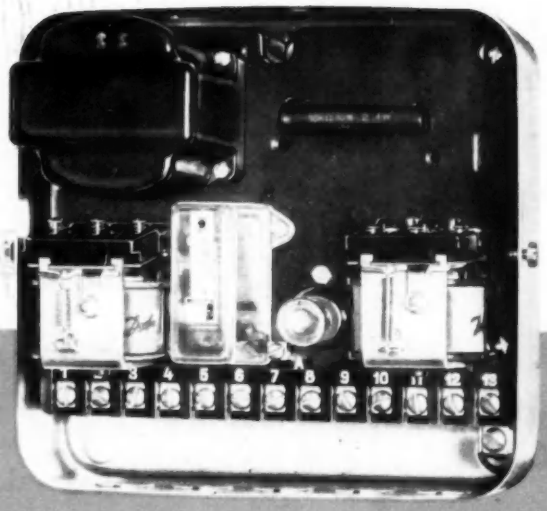

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